Stantec

INTEGRATED SANITARY MASTER PLAN

Municipal Class Environmental Assessment –
Volume 2 (Technical Memorandums)

May 2, 2024

Prepared for:
City of Kitchener

Prepared by:
Stantec Consulting Ltd.

Project Number: 165640334

Revision	Description	Author	Quality Check
Draft	Draft MP	HB / SM	JP / DE
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City of Kitchener Integrated Sanitary Master Plan – Technical Memo #3: Sanitary Servicing Analysis & Capital Infrastructure Funding and Risk Analysis and Implementation Plan

Final

Prepared for:
City of Kitchener

Prepared by:
Stantec Consulting Ltd.

Revision	Description	Author		Quality Check	Independent Review
0	Draft TM3	AL	HB	JP	FB
1	Final TM3	AL	HB	JP	FB

Sign-off Sheet

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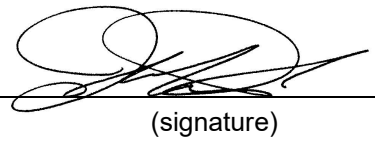
Reviewed by 
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Executive Summary

The Technical Memo #3: Sanitary Servicing Analysis & Capital Infrastructure Funding and Risk Analysis and Implementation Plan is a comprehensive document that outlines the existing and future conditions assessment, and recommended improvements for the city's sanitary sewer system. The primary goal of this report is the development of capacity-based and condition-based solutions as well as integrated mitigation and data acquisition programs.

The report begins by assessing the current state of the sanitary sewer system. This includes an evaluation of the system's capacity, condition, and performance. It also identifies any existing issues or deficiencies that need to be addressed. The report then projects the future needs of the system based on anticipated population growth. This helps to identify any potential capacity issues that may arise in the future.

Based on the assessment of the current state and future needs, the report provides a list of recommended improvements. Eight (8) capacity-based solutions were proposed to the identified capacity constraints:

- CB-1: Upstream of King St SPS: Replacement of 2 lengths of sewer - upsize from 300 mm diameter to 375 mm diameter sewer.
- CB-2: Dalewood: Alternative B - Replacement of 3 lengths of sewer on Dalewood, 2 lengths of sewer on Penrose and one length of sewer through the easement - all pipes upgraded to 300 mm diameter.
- CB-3: Homer Watson: Alternative A – Replacement of 7 lengths of sewer on Homer Watson due to capacity, replacement of 2 lengths of sewer on comm. property due to capacity/condition, replacement of 7 lengths of sewer on Alpine due to capacity/condition, replacement of 2 lengths of sewer on Flint due to capacity, replacement of 1 length of sewer on Kingswood due to condition.
- CB-4: Sandrock Trunk: Replacement of 3 lengths of sewer - upsizing from 675 mm diameter to 750 mm diameter sewer.
- CB-5: Shirley SPS: Increase PS capacity to 378 L/s firm capacity - project involves addition of pumps to accommodate higher flows *(Upgrade to be paid for by Township of Woolwich))*
- CB-6: New Dundee SPS: Increase PS capacity to 75 L/s firm capacity – project involves addition of pumps to accommodate higher flows.
- CB-7: Robert Ferrie: Replacement of 1 length of sewer downstream of New Dundee FM discharge to 375mm diameter.

- CB-8: Manchester: Replacement of 2 lengths of sewer to 825mm diameter downstream of Shirley and Manchester SPS discharge.

Furthermore, the CCTV score indicated that certain gravity sewers are presently in poor condition. As a result, 76 sewer asset renewal initiatives have been identified for targeted repair, relining, or reconstruction.

Moreover, the report delineates a number of strategic measures designed to enhance the data acquisition of the sanitary sewer system. These measures encompass initiatives associated with asset management, updates to the hydraulic model, data acquisition techniques (such as CCTV and Smartball), flow monitoring, and Infiltration/Inflow mitigation programs.

The Opinion of Probable Cost (OPC) is classified as Class D estimates, with a variance of +/- 25-30%, and is calculated in 2022 dollars. These costs have been approximated to the nearest thousand. The OPC for the Capital projects, spanning from 2024 to 2031, is estimated to be $64,578,000, while the data acquisition is estimated to cost $8,855,000 over the next four years. These OPCs can serve as a valuable resource for the City's quadrennial budgeting process. The implementation plan distributes the total cost across the years 2024 to 2031.

The Sanitary Servicing Analysis & Capital Infrastructure Funding and Risk Analysis and Implementation Plan acts as a guiding beacon for the city's future sanitary sewer system. The execution of the proposed condition-based and capacity-based solution, as well as the data acquisition will contribute to delivering a good level of service to the residents and enhance our comprehension of the sanitary system conditions.

Glossary

ADWF	Average Dry Weather Flow
ASF	Average Sewage Flow
C of A	Certificate of Approval
DEM	Digital Elevation Model
DN	Disconnected Node
DNP	Disconnected Node & Pipe
DWF	Dry Weather Flow
EA	Environmental Assessment
ECA	Environmental Compliance Approval
EMP	Employment
FM	Flow Monitor
FS	Flow Split
GIS	Geographic Information Systems
GWI	Groundwater Infiltration
HGL	Hydraulic Grade Line
HP	High Point
ICI	Industrial-Commercial-Institutional (Land Use)
ICM	Integrated Catchment Modelling
I/I	Infiltration and Inflow
IPI	Inconsistent Profile Based on Inverts
ISAN-MP	Integrated Sanitary Master Plan
MH	Maintenance Hole
MDSI	Missing Downstream Invert
MDSN	Missing Downstream Node
MUSI	Missing Upstream Invert
MUSN	Missing Upstream Node
OPC	Opinion of Probable Cost
PAG	Pipe Above Ground
PLUM	Region of Waterloo's Population and Land Use Model
PPJ	Parcel-People-Jobs Data
PS	Pumping Station

GLOSSARY
March 18, 2024

RDII	Rainfall-Derived Infiltration and Inflow
RES	Residential
RG	Rain Gauge
ROP	Regional Official Plan
SA	Area-Based Sanitary Subcatchment
SAN	Sanitary
SCADA	Supervisory Control and Data Acquisition
SP	Parcel-Based Sanitary Subcatchment
SPS	Sewage Pumping Station
SQL	Structured Query Language
TM	Technical Memorandum
WWF	Wet Weather Flow
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

The City of Kitchener (City) has retained Stantec Consulting Ltd. (Stantec) to complete an Integrated Sanitary Master Plan (ISAN-MP). The purpose of the ISAN-MP is to develop an overall master plan to guide the future needs of the City with respect to growth development and infrastructure renewal to account for updated population and employment growth projections to the 2051 planning horizon, building on the work/studies previously completed and integrating available information from ongoing studies/programs. Following the Class Environmental Assessment (EA) Process, priority and strategic projects will be evaluated to continue to efficiently and effectively operate the system, implement best management practices (including growth tracking and digital innovation), and practice sustainable staging and funding of capital projects.

The following tasks will be carried out for the completion of the ISAN-MP, including a series of Technical Memoranda (TM) that will comprise the content of the final Master Plan document:

- Task 1: Background Data Review (TM#1)
- Task 2: Hydraulic Analysis (TM#2)
- Task 3: Sanitary Servicing Analysis (TM#3)
- Task 4: Capital Infrastructure Funding and Risk Analysis (TM#4)
- Task 5: Design Criteria, Level of Service & Sensitivity Analysis (TM#5)
- Task 6: Growth Management and Implementation Plan (TM#6)
- Task 7: Communications and Community Engagement
- Task 8: Sanitary Servicing Master Plan / Innovation Strategy

Based on discussions with the City, **Task 3** has been compiled with **Task 4** and **Task 6** for this submission and involves the review and assessment of the existing sanitary sewer infrastructure in both existing and future conditions, and the development of capacity-based and condition-based solutions as well as integrated mitigation and data acquisition programs. To date, all of these assessments and recommendations have been reviewed and discussed with the City.

1.1 OVERVIEW

The work of the preceding Technical Memoranda #1 and #2 come together to define the preferred approach for the Kitchener Integrated Sanitary Master Plan model update.

Through the development of TM#1, relevant background reports, GIS data, populations and land use, natural heritage data, GIS sewer network data, and flow monitoring and rain gauge data were reviewed and assessed for data gaps and quality. Pumping station data and statuses were also reviewed, revealing wet well and pump data for all existing pumping stations, and updated condition assessment reports (2020/2021) for 20 of the 25 stations. Notably, it was identified that the Bleams Sewage Pumping Station (SPS) recently underwent decommissioning, while the Old Mill SPS is currently being rebuilt (now the

New Old Mill SPS), and the Nathalie SPS is undergoing construction. Since the submission of TM#1, two additional condition assessment reports were provided for the Bridgeport and Spring Valley Pumping Stations, which are both Regional pumping stations.

TM#2 documents the evaluation and selection of the modelling software (InfoWorks ICM), as well as a general overview of the provided hydraulic model, which was developed in InfoSWMM in 2011 and was later updated in 2019 by AECOM using 2016 sewer flow monitoring data. It also outlined the modelling plan for the current ISAN-MP project regarding both model updates and calibration, which included discussions of the following:

- New infrastructure and developments integration;
- The detailed engineering validation error assessment and fixes applied to the original model network and new network elements added to the model;
- The methodology followed to implement fixes to the errors/warnings identified;
- Subcatchment delineation and parameter development;
- Pumping station updates; and,
- Boundary conditions.

The updated model was used in the calibration process, which is also documented in TM#2, along with the flow monitoring and rainfall data quality and review, the resulting DWF and WWF calibration fits, and the final metershed flow generation parameters. Based on the calibration, the monitored portions of the sanitary system were found to have relatively low GWI and RDII contributions and reasonable per capita rates throughout. Metersheds with higher or lower than average rates were discussed. The model is considered calibrated and deemed appropriate for the existing and future conditions system assessments based on the flow monitoring data obtained. This TM also outlined the proposed modelling scenarios to be completed as part of Task 3, for the purposes of assessing the sanitary sewer system responses under existing and future conditions and constraints. Several scenarios are recommended, capturing the Existing, Future 2031, and Future 2051 DWF, 5-year, 10-year and 25-year storm event system response, in addition to a Future 2051 Climate Change scenario, and five (5) critical failure scenarios.

2.0 EXISTING CONDITIONS

The calibrated model detailed in TM2 is used as the basis of the capacity-based existing conditions system assessment and solution development. **Section 2.1** documents the infrastructure and flow updates completed between calibration and system assessment, as well as the existing conditions capacity-based system performance.

A condition-based system assessment was also completed on the existing infrastructure and is discussed in **Section 2.2** below. Additionally, current programs and program gaps are discussed in **Section 2.3**.

2.1 MODEL UPDATES AND CAPACITY-BASED SYSTEM ASSESSMENT

The flow generation parameters, boundary conditions and infrastructure updates used in the model to assess the existing conditions sanitary sewer system from a capacity perspective are outlined in **Sections 2.1.1**, **2.1.2**, and **2.1.3**, respectively. The resulting capacity-based system performance based on the 25-year, 12-hr AES design storm event for sewers and the 10-year, 12-hr AES design event for pumping stations are discussed and illustrated in **Section 2.1.4**.

2.1.1 Flow Generation

The populations, areas and flow generation rates established as part of the calibration phase were maintained for the existing conditions model.

2.1.2 Boundary Conditions

The boundary conditions established as part of the calibration process were used in the existing conditions model, with the exception of the Shirley SPS inflow from Woolwich. In calibration, an average inflow rate of 12.7 L/s was derived from 2021 monitoring data from the MH just upstream of the SPS and applied accordingly. For the system assessments however, this value was conservatively increased to the Cross-Border Agreement's maximum flow of 189 L/s from Woolwich. **Table 2-1** below documents the boundary conditions applied in both the existing conditions assessments.

Table 2-1: Existing Model Boundary Conditions

Location No.	Location (Sewershed)	MH/ Modelled Node ID	Second Party in Cross Border Agreement	Boundary Condition Type	FM Metershed	Value Applied
1	Upper Schneider - Henry Sturm Direct	310088	Waterloo	Inflow	FM2	30.00 L/s

Location No.	Location (Sewershed)	MH/ Modelled Node ID	Second Party in Cross Border Agreement	Boundary Condition Type	FM Metershed	Value Applied
2	Upper Schneider - Borden	311511	Wilmot	Inflow	FM5b	7.05 L/s
3	Melitzer	311933	Waterloo	Inflow	FM19	Accounted for in GWI Rate
4	Bridgeport	JCT-236	Waterloo	Inflow	Unmonitored	Accounted for in GWI Rate
5	Melitzer	JCT-736	Waterloo	Inflow	FM19	Accounted for in GWI Rate
6	Montgomery - Kolb	JCT-88	Safety Kleen	Inflow	FM9	38.00 L/s (2 am to 5 am)
7	Montgomery - Kolb	Shirley-Dummy-Inflow	Woolwich	Inflow	FM10	189.00 L/s
8	Upper Schneider Westmount Direct	306155	Waterloo	External Subcatchment	FM2b	61 Units x 3.5 PPU
9	Montgomory – Spring Valley North	JCT-256	Waterloo	External Subcatchment	Unmonitored	38 Units x 3.5 PPU
10	Gateway Park	303424	Cambridge	Level	FM20	294.93 m (Pipe Obvert)
11	Lower Schneider – Direct	WWTP	N/A	Level	Unmonitored	Free Flowing

2.1.3 Infrastructure Updates

The Middle Strasburg Trunk Sanitary Sewer (MSTSS), commissioned on October 29, 2021, conveys flows from the Middle Strasburg area to the South Strasburg area via gravity. Previously, the Bleams SPS pumped these flows north to the Upper Schneider drainage area. The Bleams SPS was decommissioned upon MSTSS commissioning. For calibration, these infrastructure updates were not included in the model as the calibration period preceded this transition. For existing conditions however, the MSTSS is considered operational, and the Bleams SPS is no longer online. Thus, these infrastructure updates are included in the existing conditions model. The MSTSS As-Constructed drawings were referenced as part of this update.

During the process of assessing the existing conditions system, additional locations were questioned and deemed in need of updates. As recorded drawings were used to make the majority of these adjustments with the intent of more accurately understanding the nearby capacity constraints observed. In some cases, it was also established that the previous model from 2019 had not been updated to include sewer upgrades that occurred prior to that model update. These infrastructure updates include:

- A single sewer invert correction just upstream of the King St SPS eliminating a severe inconsistent profile within close proximity to observed capacity constraints;
- Sewer invert corrections within the Dalewood St area;
- Sewer invert corrections along the Wabanaki Trunk downstream of the King St SPS forcemain discharge point;
- Diameter and invert adjustments for portions of the Sandrock Trunk sewer; and,
- Invert corrections at the Conestoga, Highland, and Borden siphons.

Refer to **Figure 2-1** illustrating the location of these updates. All adjustments are documented in the ICM model using a series of flags and engineering validation fix codes stored within the 'User Text 10' field on both conduits and nodes.

2.1.3.1 Pump Station Updates

Most pumping stations modelled during calibration were maintained within the existing conditions scenario modelling, with the exception of the Bleams SPS, which was decommissioned and replaced with the MSTSS, as discussed in **Section 2.1.3**. Additionally, the Nathalie SPS was commissioned post-calibration period and is thus included in the existing conditions infrastructure updates.

All pumping stations are idealized in the existing conditions model; allowing all incoming flow to be pumped through the station without constraint (Qin = Qout). This provides a straightforward comparison of the unrestricted incoming peak flow during the design event to the pumping station's firm and rated capacities to identify the need for upgrades. The firm capacity of a pumping station is defined as the maximum pumping capacity with the largest pump offline. The rated capacity is defined as the designed operational capacity of the pumping station and usually does not include the simultaneous operation of the standby pump(s). Both the firm and rated capacities were obtained for each pumping station from the most recent Condition Assessment Report. If available, the theoretical duty points from the system and pump curve analysis, and the known operation of the pumps (number of duty and standby pumps) informed the firm and rated capacities used in this analysis. While the current operating capacity of the pumps may be lower than the theoretical capacities due to deteriorating conditions, it is assumed that the theoretical capacity will be achieved through planned maintenance. If the operating capacity exceeds the theoretical, the theoretical is conservatively applied to account for future depreciation. These values may differ from the firm capacities noted in the pumping station Environmental Compliance Approval (ECA) (formerly the Certificate of Approval (C of A)) which can be less accurate based on pump and system performance.

If the total flow through the idealized pump is greater than that of the pumping station's rated capacity, this value is applied to the ideal pump as a maximum pump rate. This allows for an evaluation of the upstream system response and the occurrence of overflows at the pumping station under maximum pumping conditions. The flow through the ideal pumps will also be compared to the firm capacity from the ECA to determine if the current approval is adequate for existing and future conditions flows or requires amendment. See **Section 2.1.5.1** for more details on the pumping station's performance criteria.

The following **Table 2-2** lists the pumping station's firm and rated capacities used in this analysis, the ECA firm capacity, and provides additional relevant notes where applicable.

Table 2-2: Existing Pumping Station Firm & Rated Capacities Based on Theoretical Operation

Pumping Station	Firm Capacity (L/s)	Rated Capacity (L/s)	Rated Capacity Pump Operation	ECA Firm Capacity (L/s)	Additional Notes
Apple Tree SPS	66.0	66.0	2 Duty ON; 1 Standby OFF	50.0	
Bancroft SPS	7.7	7.7	1 Duty ON; 1 Standby OFF	7.7	
Bridgeport SPS	136.0	136.0	1 Duty ON; 1 Standby OFF; 1 Jockey for low flow conditions	136.0	The firm and the rated capacities correspond to the capacity of the duty pump only; jockey pump ignored for capacity assessment (likely cannot run simultaneously to duty pump) Owned and operated by the Region of Waterloo
Carson SPS	66.9	66.9	1 Duty ON; 1 Standby OFF	Not Available	The rated and the firm capacities are based on the drawdown test (operational capacities instead of theoretical), as no pump curve was provided in the Condition Assessment report Firm capacity not noted in ECA
Chandos SPS	27.0	27.0	1 Duty ON; 1 Standby OFF	30.0	
Conestoga College SPS	47.5	47.5	1 Duty ON; 1 Standby OFF	50.0	

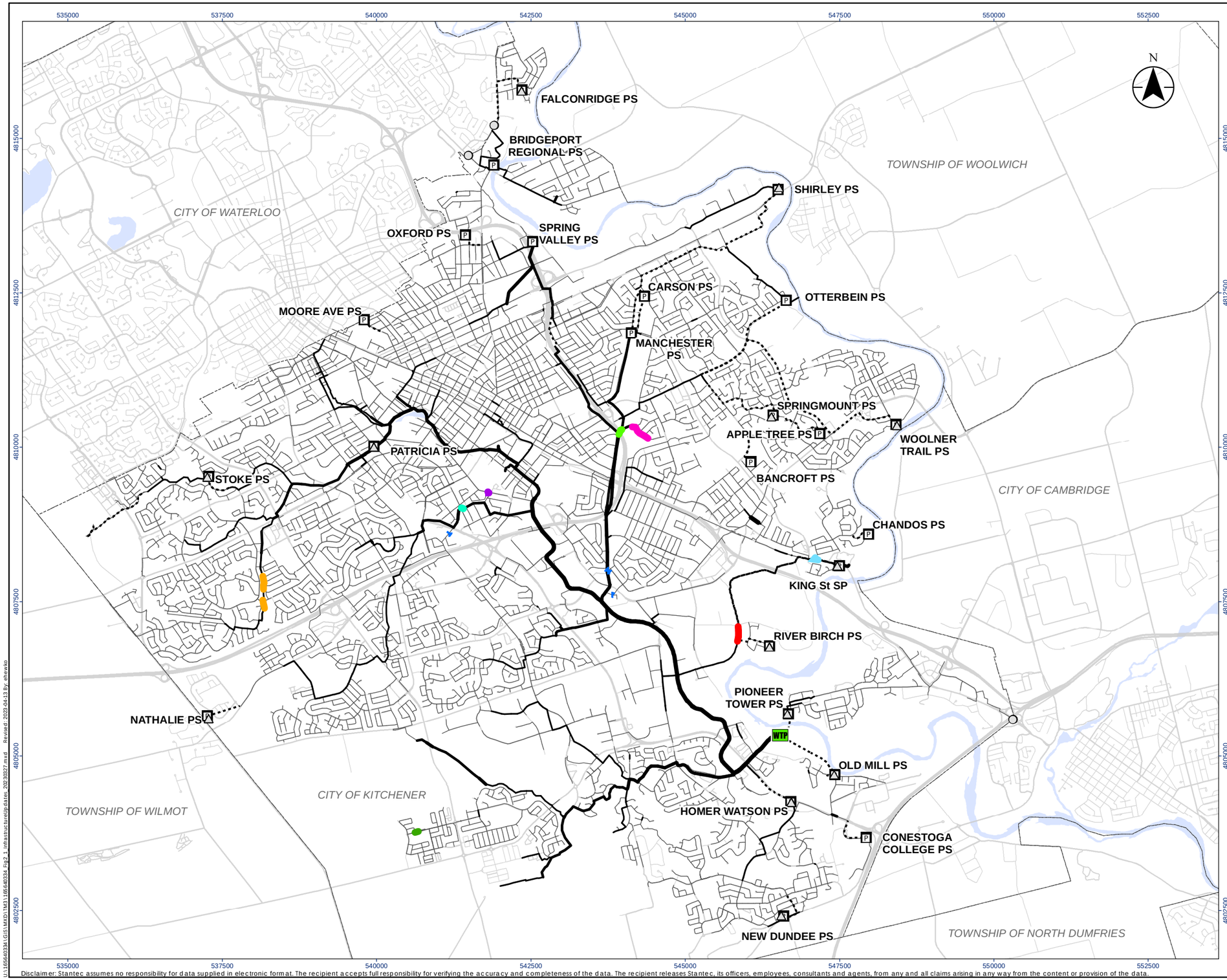
Pumping Station	Firm Capacity (L/s)	Rated Capacity (L/s)	Rated Capacity Pump Operation	ECA Firm Capacity (L/s)	Additional Notes
Falconridge SPS	45.5	45.5	1 Duty ON; 1 Standby OFF	118.0	The pump's operational capacities are higher than the theoretical capacity; however, the theoretical capacity was conservatively used ECA firm capacity represents future conditions with two additional provisional pumps installed
Homer Watson SPS	314.0	314.0	2 Duty ON; 1 Standby OFF	310.0	The station normally operates with only 1 duty on at a time, alternating between the three pumps The ECA does not include the firm capacity; this value was instead obtained from the Operation and Maintenance Manual (as per the 2021 Condition Assessment Report)
King St SPS	176.0	176.0	1 Duty ON; 2 Standby OFF	290.0	The station normally operates with only 1 duty on at a time, alternating between the three pumps
Manchester SPS	240.0	240.0	1 Duty ON; 1 Standby OFF	240.0	No system/pump curves or drawdown test results provided in Condition Assessment report; assumed firm and rated capacity is equivalent to the rated capacity of a single pump
Moore SPS	21.5	23.5	1 Duty ON; 1 Standby OFF	Not Available	Two different pumps; pump 2 is larger than pump 1 resulting in different firm and rated capacities ECA not available
Nathalie SPS	98.0	98.0	2 Duty ON; 1 Standby OFF	98.0	Station operates with one duty pump at a time, alternating between three pumps. Ultimate peak flow: 98 L/s. Each pump rated at 74 L/s at a TDH of 37.5 metres.
New Dundee SPS	56.0	56.0	1 Duty ON; 1 Standby OFF	56.0	No system/pump curves or drawdown test results provided in Condition Assessment report; assumed firm and rated capacity is equivalent to the rated capacity of a single pump, as per the ECA

Pumping Station	Firm Capacity (L/s)	Rated Capacity (L/s)	Rated Capacity Pump Operation	ECA Firm Capacity (L/s)	Additional Notes
Old Mill SPS[1]	Unknown	Unknown	Unknown	Unknown	No information provided on existing Old Mill SPS; although this pumping station is present in existing conditions, it will soon be replaced by New Old Mill SPS. It is located immediately upstream of the WWTP, thus has very little impact on the downstream system Modelled as an unrestricted idealized pump station in existing conditions
Otterbein SPS	88.7	88.7	2 Duty ON; 1 Standby OFF	126.0	The rated and the firm capacities are based on the drawdown test (operational capacities instead of theoretical), as no pump curve was provided in the Condition Assessment report Currently in EA process; recommended SPS upgrade to a total future capacity of 165 L/s
Oxford SPS	49.0	49.0	1 Duty ON; 1 Standby OFF	Not Available	ECA not available
Patricia SPS	23.5	23.5	1 Duty ON; 1 Standby OFF	Not Available	ECA not available
Pioneer Tower SPS	70.0	70.0	1 Duty ON; 1 Standby OFF	125.1	City confirmed the ECA firm capacity for this SPS is as per Genivar's Condition Assessment Report from 2012 (125.1 L/s) The pump station has been upgraded.
River Birch SPS	19.0	19.0	1 Duty ON; 1 Standby OFF	17.3	The pump's operational capacities are higher than the theoretical capacity; however, the theoretical capacity was conservatively used
Shirley SPS	207.0	207.0	1 Duty ON; 1 Standby OFF	378.0	The Condition Assessment report indicates only two pumps, but the Certificate of Approval indicates three pumps. Only two pumps are assumed for conservatism

Pumping Station	Firm Capacity (L/s)	Rated Capacity (L/s)	Rated Capacity Pump Operation	ECA Firm Capacity (L/s)	Additional Notes
Spring Valley SPS	245.0	245.0	2 Duty ON; 1 Standby OFF	245.0	Spring Valley Sewage Pumping Station Municipal Class Environmental Assessment (CIMA+, November 17, 2021) notes a current firm capacity of 245 L/s No pump/system curves or drawdown test results were provided in Condition Assessment report); therefore, the noted firm capacity is assumed equivalent to the rated capacity and cannot be validated further Furthermore, the Wastewater Treatment Master Plan (2018) identified a future capacity requirement of 265 L/s to meet 2051 forecasts, and the Spring Valley SPS EA from CIMA+ recommends a near-term upgrade to achieve a 350 L/s firm capacity and an ultimate buildout upgrade to achieve a 470 L/s firm capacity. ECA not provided Owned and operated by the Region of Waterloo
Springmount SPS	162.0	162.0	2 Duty ON; 1 Standby OFF	205.5	No alternation between standby and duty pumps; standby pump is not used as a duty pump due to its age and condition
Stoke SPS	196.0	196.0	2 Duty ON; 1 Standby OFF	473.0	Pump/system curve for Pump 3 not provided; assumed equivalent to Pump 1 and 2 ECA notes initial design capacity of 164 L/s (completed in 1980) and future design capacity of 473 L/s; assumed future capacity is applicable to 2021 and beyond
Woolner SPS	136.0	136.0	2 Duty ON; 1 Standby OFF	115.2	The pump's operational capacities are higher than the theoretical capacity; however, the theoretical capacity was conservatively used

Note:

1- The Old Mill PS has been decommissioned, and the New Old Mill PS has been commissioned. However, for the purposes of this assessment, the existing conditions as of 2021 were considered, in accordance with the flow monitoring data used for calibrating the existing conditions.



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Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon

Sewer Diameter (mm)

- 100 - 449
- 450 - 675
- 676 - 900
- 901 - 1350
- 1351 - 2500

Infrastructure Updates

- Wabanaki Trunk
- Seabrook Dr
- Dalewood St
- King St
- Sandrock
- Borden Siphon
- Conestoga Siphon
- Highland Siphon

0 1 2 km

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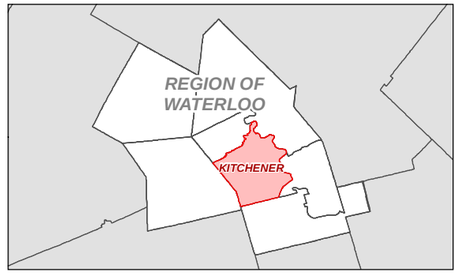
Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2021.
3. Contains information licensed under the Open Government Licence - The Corporation of the City of Kitchener, 2021.



Project Location
City of Kitchener

165640334 REVA
Prepared by EH on 2023-04-13

Client/Project
CITY OF KITCHENER
INTEGRATED SANITARY MASTER PLAN

Figure No.
2.1

Title
Infrastructure Updates

2.1.4 Wastewater Treatment Plant Flow Validation

Since the submission of TM2, 2021 SCADA data was obtained for the City of Kitchener Wastewater Treatment Plant (WWTP), which is operated by the Region of Waterloo. This information consisted of influent flows measured every 5-minutes in m^3/d from July 1st to November 30th, 2021. The results of this validation indicate that the model adequately replicates the flows at the WWTP when compared to observed data for all DWF periods and WWF events selected for calibration as part of **Task 2**. The following **Figure 2-2** and **Figure 2-3** illustrate the comparison of observed and modelled peak dry weather flows and volumes, respectively, while **Figure 2-4** and **Figure 2-5** illustrate the wet weather peak flow and volume comparisons. As shown, both the DWF and WWF event fits straddle the 1:1 line (some are high and others low), indicating a generally good fit overall. Validation results graphs are presented in **Appendix A**.

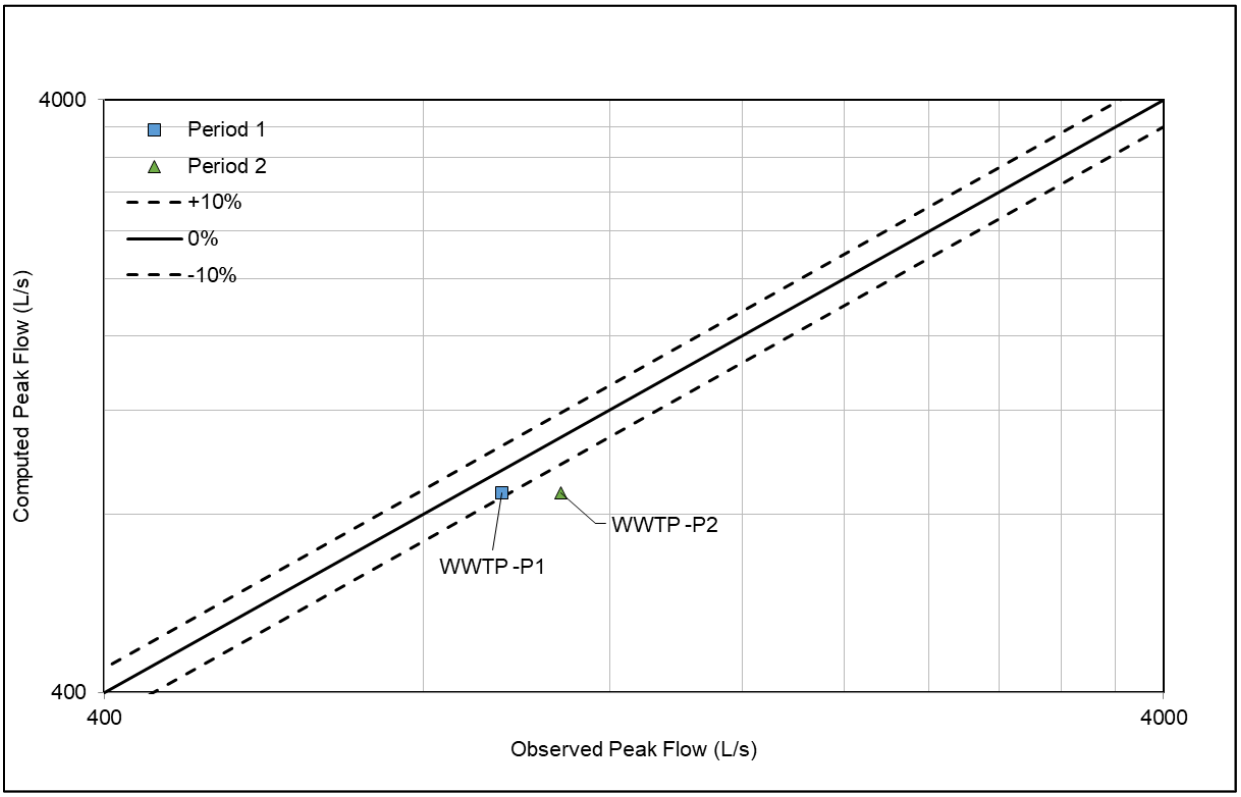


Figure 2-2: WWTP Dry Weather Validation Results - Peak Flow

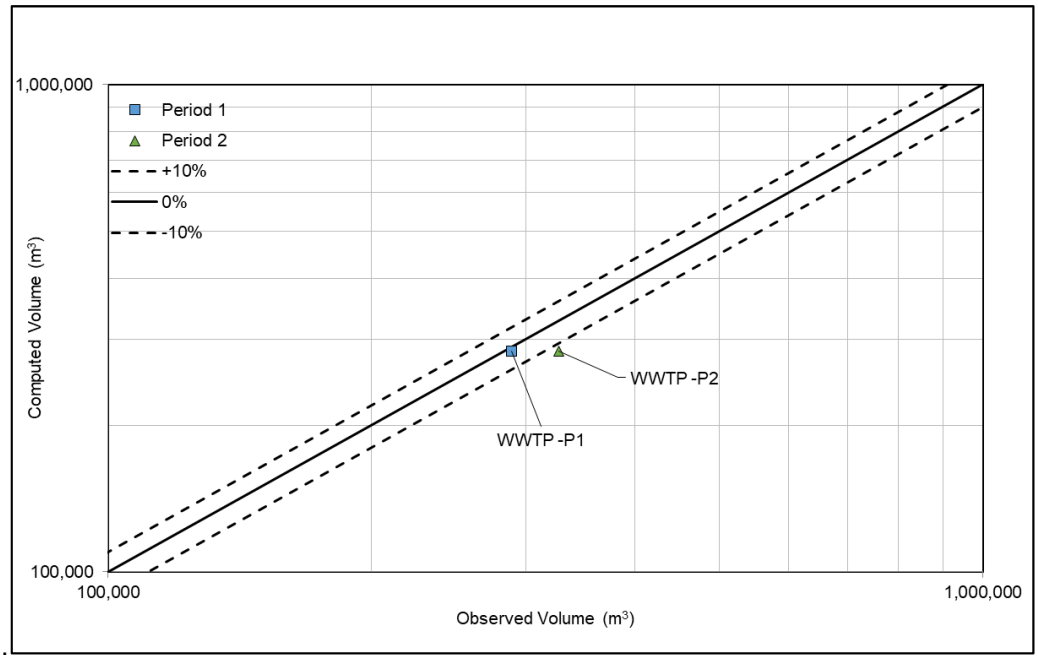


Figure 2-3: WWTP Dry Weather Validation Results – Volume

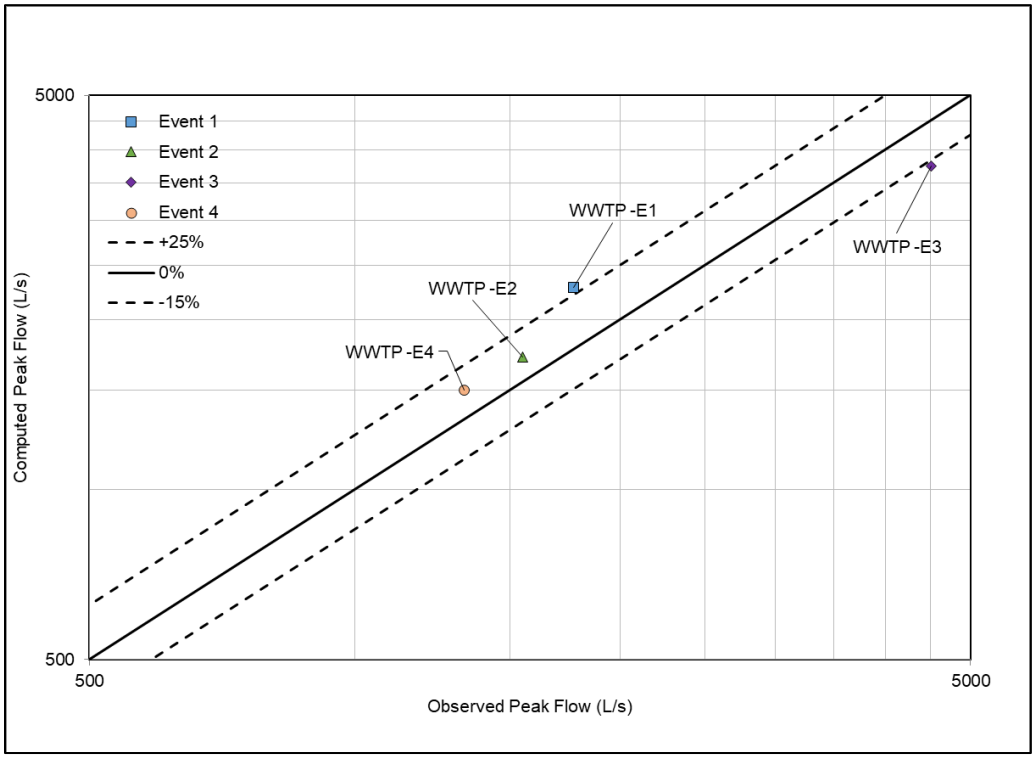


Figure 2-4: WWTP Wet Weather Validation Results - Peak Flow

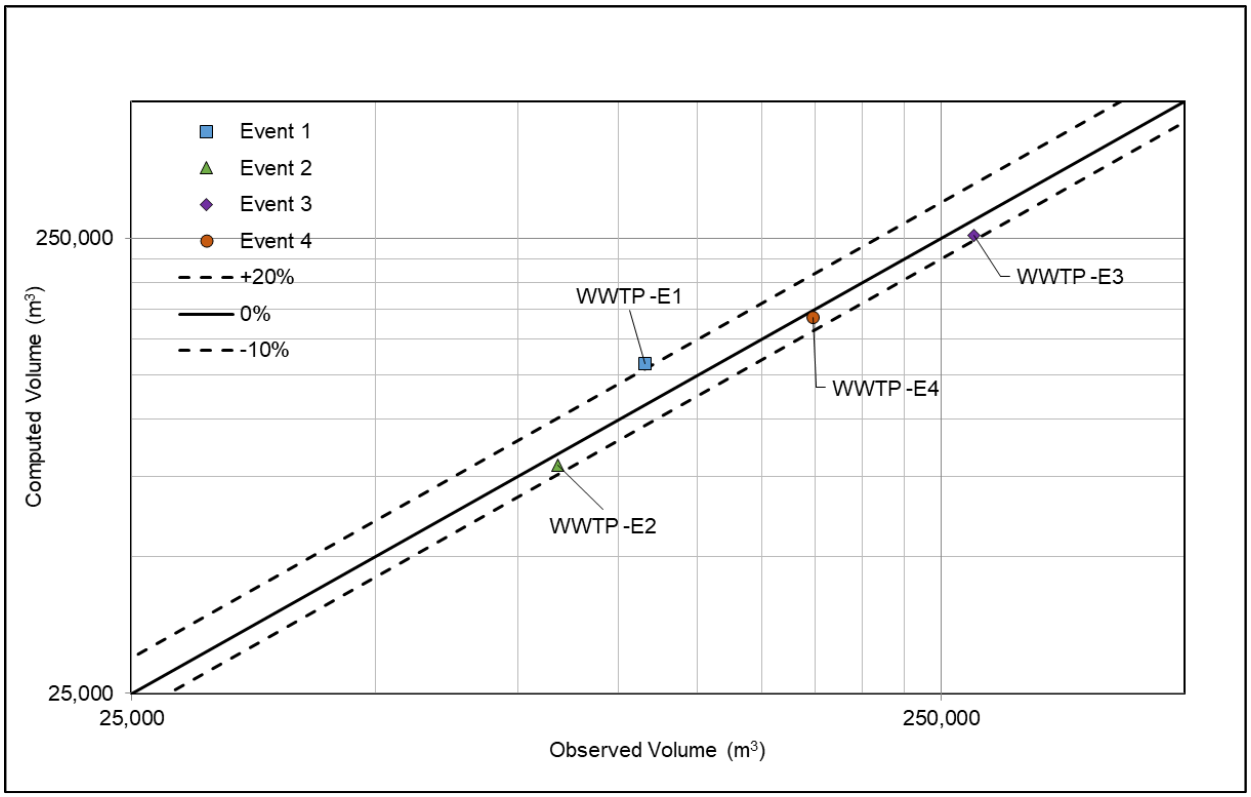


Figure 2-5: WWTP Wet Weather Validation Results - Volume

These results provide confidence in capacity constraints identified in unmonitored areas (areas downstream of flow monitors).

2.1.5 Capacity-Based System Performance

The existing conditions sanitary system is evaluated from a capacity perspective, based on design event results. The capacity-based assessment approach and results are documented in Sections **2.1.5.1** and **2.1.5.2** below.

2.1.5.1 Assessment Approach

Both the DWF and WWF conditions are reviewed as part of the sanitary sewer system performance assessment. The Hydraulic Grade Line (HGL) elevations at nodes are used as the main indicator of issues within the collection system. Elevated HGLs occur when a capacity constraint drives the upstream water levels to rise. Risk of basement flooding (or HGL issues) in this design event is considered if the HGLs are within 1.8 m from the surface elevation, which coincides with the assumed basement elevation for homes with direct or indirect basement connections to the sewer. The system is evaluated for HGL

issues in DWF conditions and during the 1:25-year AES, 12-hour storm event. This 25-year event was used in the latest system assessment performed by AECOM in 2019.

Sewer performance is reviewed in conjunction with the elevated HGLs to determine the cause of the HGL issues observed and determine possible solutions. Sewer performance alone is generally not used to define the need to provide upgrades; however, surcharging observed in smaller events like the 5-year AES, 12-hour storm may warrant upgrades. Surcharge state is used in ICM to define sewer performance, which is defined by both the d/D (depth of flow over diameter) and q/Q (flow through pipe over full pipe capacity) ratios. When the surcharge state is less than 1, the pipe is considered free-flowing. When the surcharge state is 1 or 2, the pipe is considered under backwater (slope of the HGL is less than the slope of the pipe),or bottlenecked/undersized (slope of the HGL is greater than that of the pipe), respectively.

For shallow sewers that are within 1.8 m from the surface, HGL issues may be illustrated; however, if the water level remains within the pipe and the pipe is under free-flowing conditions, it is not considered for upgrades.

For pumping stations, the 1:10-year AES, 12-hour storm event is used to assess performance. As per the *City of Kitchener Design Standards and Procedures Manual for Wastewater Pumping Facilities* (dated August 2003), all sewage pumping facilities should be designed to pump the 10-year peak flow with the largest pump offline (also referred to as ‘firm capacity’).

Thus, with the use of idealized pumps in the model, the peak flow conveyed through the pump station during the 10-year event is compared to the pumping station’s firm capacity, as described in **Section 2.1.3.1**. The pumping station’s performance is then based on this comparison; pumping stations receiving 10-year peak flows greater than the station’s firm capacity are considered to have capacity constraints. The 10-year peak flow through the ideal pumps is also compared to the firm capacity from the ECA to determine if the current ECA is adequate for existing and future conditions flows or requires amendment.

Additionally, pumping station performance is evaluated with respect to overflows, in that overflows should not occur in events smaller than the 25-year. Using the simplified idealized pump setup, the pump station’s rated capacity (i.e., maximum pumping capacity) is used to limit outflow from the station in the model. The occurrence of an overflow in events smaller than the 25-year indicates inadequate pumping station capacity.

2.1.5.2 Assessment Results

Figure 2-6, **Figure 2-7**, **Figure 2-8**, and **Figure 2-9** illustrate the existing conditions DWF, 5-year, 10-year and 25-year sanitary sewer HGL and surcharge results, respectively. These figures represent the system results generated by the application of flow limits at the pumping stations equivalent to their rated capacities, as discussed in **Section 2.1.5.1**. In some cases, this results in backwater and surcharging upstream of the pumping stations. With no restrictions applied to the pumping stations (ideal pumps), no additional capacity concerns are observed downstream and are therefore not presented. These results within these figures are presented using the following rendering:

- MH HGL (freeboard):
    - **Black**: HGL is more than 1.8 m below ground surface (i.e., low risk of basement flooding);
    - **Yellow**: HGL is within 1.8 m of ground surface (i.e., potential for basement flooding); and,
    - **Red**: HGL is above ground surface (i.e., potential for basement and surface flooding).
    - Pipe surcharge state:
    - **Black**: free-flow within sewer;
    - **Yellow**: sewer surcharged, peak flow within free-flow capacity of the sewer (i.e., under backwater conditions);
    - **Red**: sewer surcharged, peak flow greater than free-flow capacity of the sewer (i.e., sewer is undersized and causing bottleneck); and,
    - **Purple** halo: shallow sewers with less than 1.8 m between the sewer obvert and the ground surface.

Based on the presented modelling results, no capacity constraints resulting in HGL issues are observed in the DWF conditions. Excluding siphons, forcemains, or remaining inconsistent profiles, there are two (2) locations where the pipes were found to be 85% full or greater in DWF conditions, described below. Both of these locations are not considered concerns with respect to capacity constraints in the system and do not result in HGL issues in the 25-year event.

- **One 200 mm influent pipe at the Bancroft SPS (Asset ID 118789)**, running 85% full or greater due to the downstream wet well water levels and connecting invert.
- **One 250 mm pipe that connects the local system on Park St to the Westmount trunk sewer (Asset ID CDT-35).** Due to downstream water levels in the trunk and connecting inverts.

In the system, there are 13,825 pipes that have been modeled. The majority of these pipes (around 11,850 or 85.7%) exhibit maximum velocities less than 0.6 m/s under DWF conditions. When we narrow our focus to the trunk sewers within the system, we find that there are 2,088 modeled trunk sewers. And about half of these trunk sewers (approximately 1,075 or 51.5%) experience maximum velocities less than 0.6 m/s in DWF conditions.

Trunk sewers are defined as gravity pipes with 375 mm diameters or larger, forcemains, and additional smaller pipes that connect these sewers to form the system's spinal network, as per consultations with the City. There is less confidence with the local system pipes in the model due to identified engineering validation errors. These issues were resolved only where needed, as local sewers are not considered the focus of this MP.

Similar to DWF conditions, no capacity constraints resulting in HGL issues are observed in the 5-year storm event, other than the area upstream of the Old Mill SPS, which is currently being replaced by a new, higher capacity pumping station across the road (included in 2031 and 2051 conditions); and the area upstream of Shirley SPS, which is discussed further below. Excluding the area upstream of the Old Mill SPS, there are seven (7) locations that experience pipes 85% full or greater during this event due to sewer capacity constraints (including the area upstream of Shirley SPS); two (2) of which see HGL issues in the 25-year event and are described below. The remaining five (5) locations are not considered a concern as HGL issues are not generated by these capacity constraints in the 25-year design event.

- **Dalewood**, 250 mm sewers experience backwater during the 5-year event and surcharging and HGL issues in the 25-year event. This location is defined as an existing conditions problem area (SA-2); and,
- **Upstream of Shirley SPS**, HGL and surcharge issues are experienced in the 525 mm sewers in the 5- and 25-year events. This location is defined as an existing conditions problem area (SA-8).

In the 25-year design event, seven (7) Problem Areas (areas of observed sewer capacity constraints) are identified within the existing conditions system. These areas are highlighted in **Figure 2-9** and described in **Table 2-3** by Problem Area ID, where “SA” refers to Sanitary Area. All other areas with HGL issues are representative of shallow sewers, or inconsistent profiles in local areas deemed to have minimal impact to the Master Plan and thus were not updated in the model validation stages due to magnitude of profile issues observed.

Table 2-3: Existing Conditions Sanitary Sewer Problem Areas

Problem Area ID	Location	Capacity Constraint Description
SA-1 Upstream of King St SPS	King St, east of River Rd E	HGLs within 1.8 m of surface due to undersized pipes. Low risk of basement flooding as no building connections are anticipated along these sewers.
SA-2 Dalewood	Dalewood Dr and Penrose Ave	Risk of basement flooding (HGLs within 1.8 m of surface) due to undersized pipes along Dalewood Dr.
SA-3 Upstream of Spring Valley SPS	Spring Valley SPS off of Riverbend Dr	HGLs within 1.8 m of surface due to downstream capacity constraints at the Spring Valley SPS. Low risk of basement flooding as no building connections are anticipated along these sewers.
SA-6 Homer Watson	Homer Watson Blvd	Risk of basement flooding along Kingswood Dr and Flint Dr due to undersized pipes within the private ICI property and on Homer Watson Blvd. HGLs within 1.8 m of surface on Alpine Rd and Homer Watson Blvd with low risk of basement flooding as no building connections are anticipated along these sewers.

Problem Area ID	Location	Capacity Constraint Description
SA-7 Sandrock Trunk	Highland Rd W and Fischer-Hallman Rd	HGLs within 1.8 m of surface due to undersized pipes along Highland Rd W. Low risk of basement flooding as no building connections are anticipated along these sewers.
SA-8 Upstream of Shirley SPS	Shirley Dr and Victoria St N	Risk of basement flooding and surface flooding along Shirley Dr due to downstream capacity constraints at the Shirley SPS. HGLs within 1.8 m of surface on Victoria St N with low risk of basement flooding as no building connections are anticipated along these sewers.
SA-10 Upstream of Bridgeport SPS	Bridge St E between Bloomingdale Rd and Grand Ave	Risk of basement flooding on Bridge St E due to downstream capacity constraints at the Bridgeport SPS. Risk of PS flooding.

Additionally, the 10-year incoming peak flows are compared to the pumping station's firm, rated and ECA capacities to determine performance or approval issues. The following **Table 2-4** presents these results, along with the 25-year peak incoming flows for reference. The ECA, firm and rated capacities surpassed by the 10-year incoming flow are noted in **red**, illustrating the pump stations that do not meet criteria. The 10-year flows draining to the Bridgeport SPS, Pioneer Tower SPS, Shirley SPS and Spring Valley SPS exceed their firm and rated capacities. However, Pioneer Tower SPS capacity have been upgraded by the City after the assessment, therefore this PS is no longer a concern. The 10-year incoming flows to Bridgeport SPS and Spring Valley SPS also exceed their current ECA approved rates. Note that the Bridgeport SPS and Spring Valley SPS are owned by the Region of Waterloo and not the City of Kitchener.

Table 2-4: Existing Conditions Pumping Station Performance

Pumping Station	Incoming 10-Year Peak Flow (L/s)	Incoming 25-Year Peak Flow (L/s)	ECA Capacity (L/s)	Firm Capacity (L/s)	Rated Capacity (L/s)	Notes
Apple Tree SPS	38.4	47.6	50.0	66.0	66.0	
Bancroft SPS	4.6	5.7	7.7	7.7	7.7	
Bridgeport SPS*	175.2	211.9	**136.0**	**136.0**	**136.0**	
Carson SPS	37.5	49.5	N/A	66.9	66.9	No ECA available
Chandos SPS	7.1	9.2	30.0	27.0	27.0	
Conestoga College SPS	2.9	3.6	50.0	47.5	47.5	
Falconridge SPS	15.2	17.7	118.0	45.5	45.5	
Homer Watson SPS	73.2	86.9	310.0	314.0	314.0	
King St SPS	136.0	171.6	290.0	176.0	176.0	

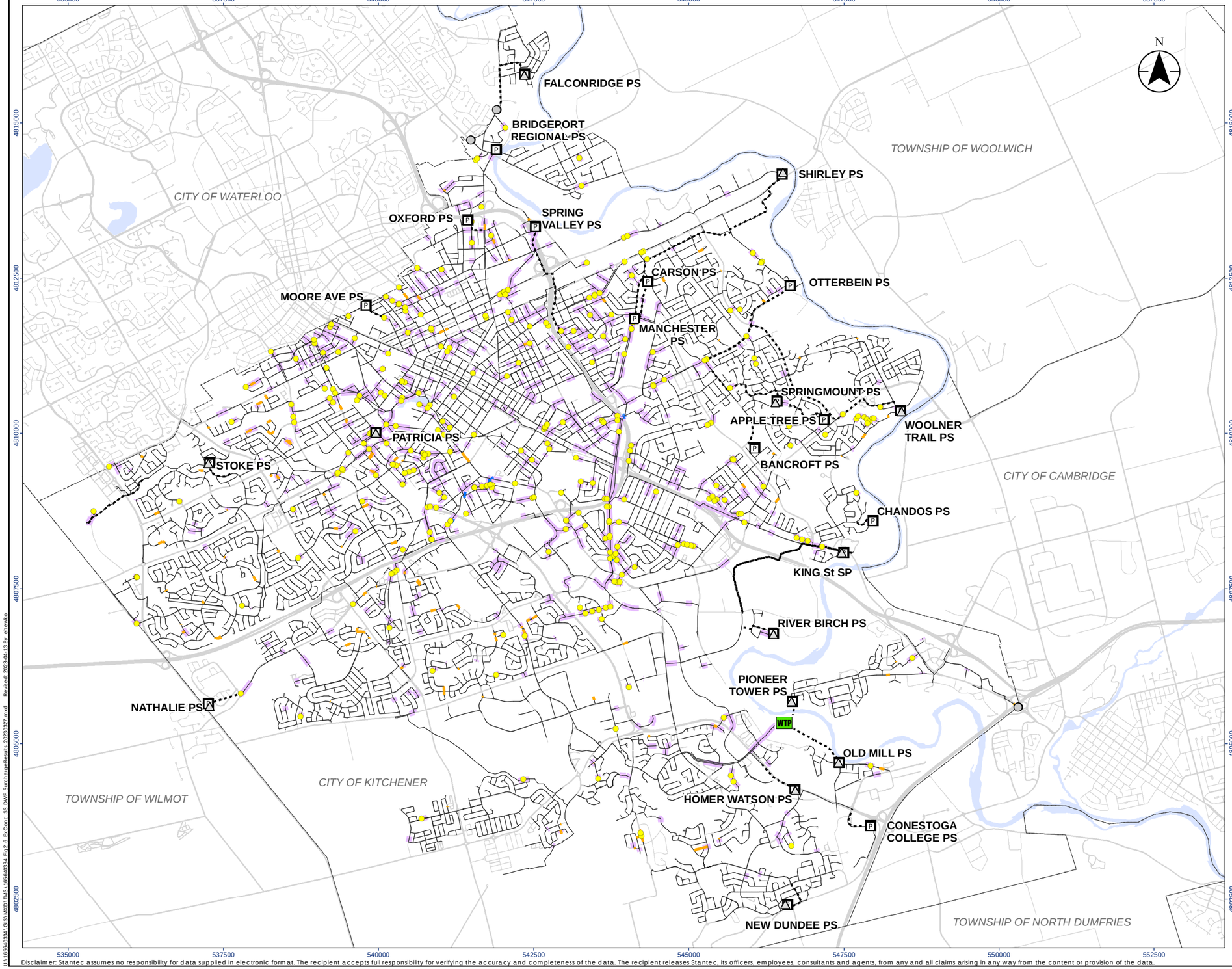
Pumping Station	Incoming 10-Year Peak Flow (L/s)	Incoming 25-Year Peak Flow (L/s)	ECA Capacity (L/s)	Firm Capacity (L/s)	Rated Capacity (L/s)	Notes
Manchester SPS	158.9	207.6	240.0	240.0	240.0	
Moore SPS	11.9	15.3	N/A	21.5	23.5	No ECA available
New Dundee SPS	7.4	9.3	56.0	56.0	56.0	
Old Mill SPS	70.6	81.8	N/A	N/A	N/A	To be replaced by New Old Mill SPS
Otterbein SPS	54.0	57.3	126.0	88.7	88.7	EA for proposed upgrades provided; notes future 165 L/s design capacity
Oxford SPS	31.2	41.0	N/A	49.0	49.0	No ECA available
Patricia SPS	3.9	4.8	N/A	23.5	23.5	No ECA available
Pioneer Tower SPS	77.7	90.1	125.1	**70.0**	**70.0**	Pump station has been upgraded
River Birch SPS	9.6	12.8	17.3	19.0	19.0	
Shirley SPS	222.5	231.3	378.0	**207.0**	**207.0**	
Spring Valley SPS*	252.9	319.6	**245.0**	**245.0**	**245.0**	Currently in design process for SPS upgrades
Springmount SPS	98.8	122.6	205.5	162.0	162.0	
Stoke SPS	62.4	69.2	473.0	196.0	196.0	
Woolner SPS	80.1	97.7	115.2	136.0	136.0	
Nathalie SPS**	0.0	0.0	148.0	98.0	98.0	

Notes:

* Bridgeport SPS and Spring Valley SPS are owned by the Region of Waterloo

** Nathalie SPS sees no incoming flows in existing conditions as the area draining to this station has no population attributed to it for this scenario (still under development).

In **Figure 2-8** and **Figure 2-9**, the pumping stations are rendered based on the whether the 10-year and 25-year flows, respectively, exceed the pumping station's ECA, firm or rated capacities in existing conditions. See figure legends for details.



Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon
- Shallow Pipes (Obvert <= 1.8m of Surface)

HGL Freeboard

- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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Notes

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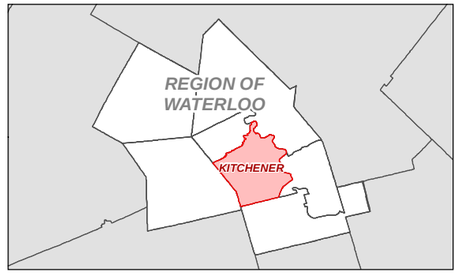

Project Location
City of Kitchener

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Prepared by EH on 2023-04-13

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Figure No.
2.6

Title
Existing Conditions Sanitary Sewer System
Dry Weather Flow HGL & Surcharge Results

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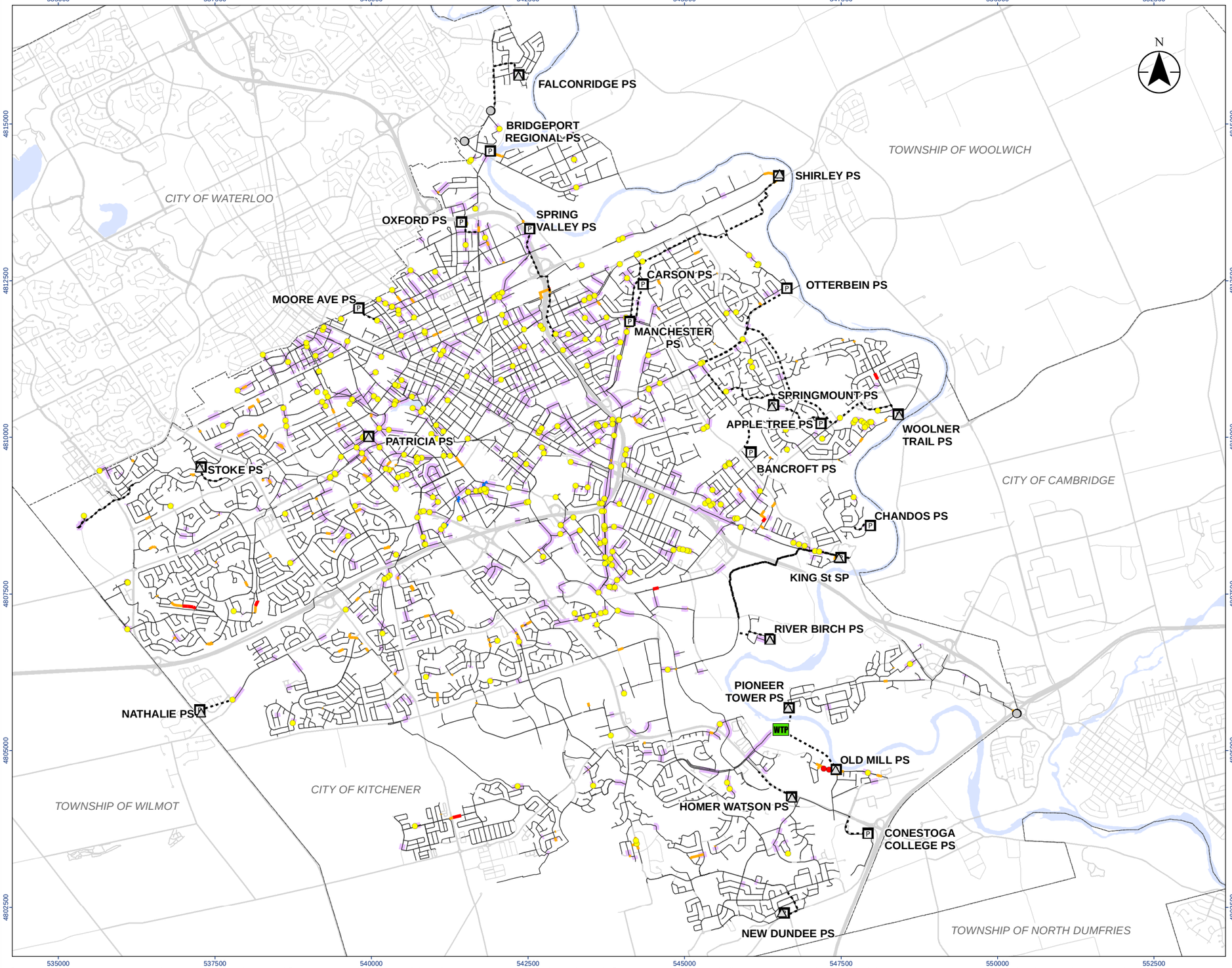

Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon
- Shallow Pipes (Obvert <= 1.8m of Surface)

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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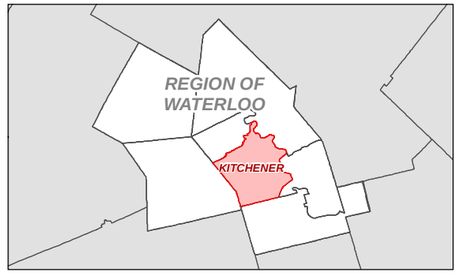

Project Location
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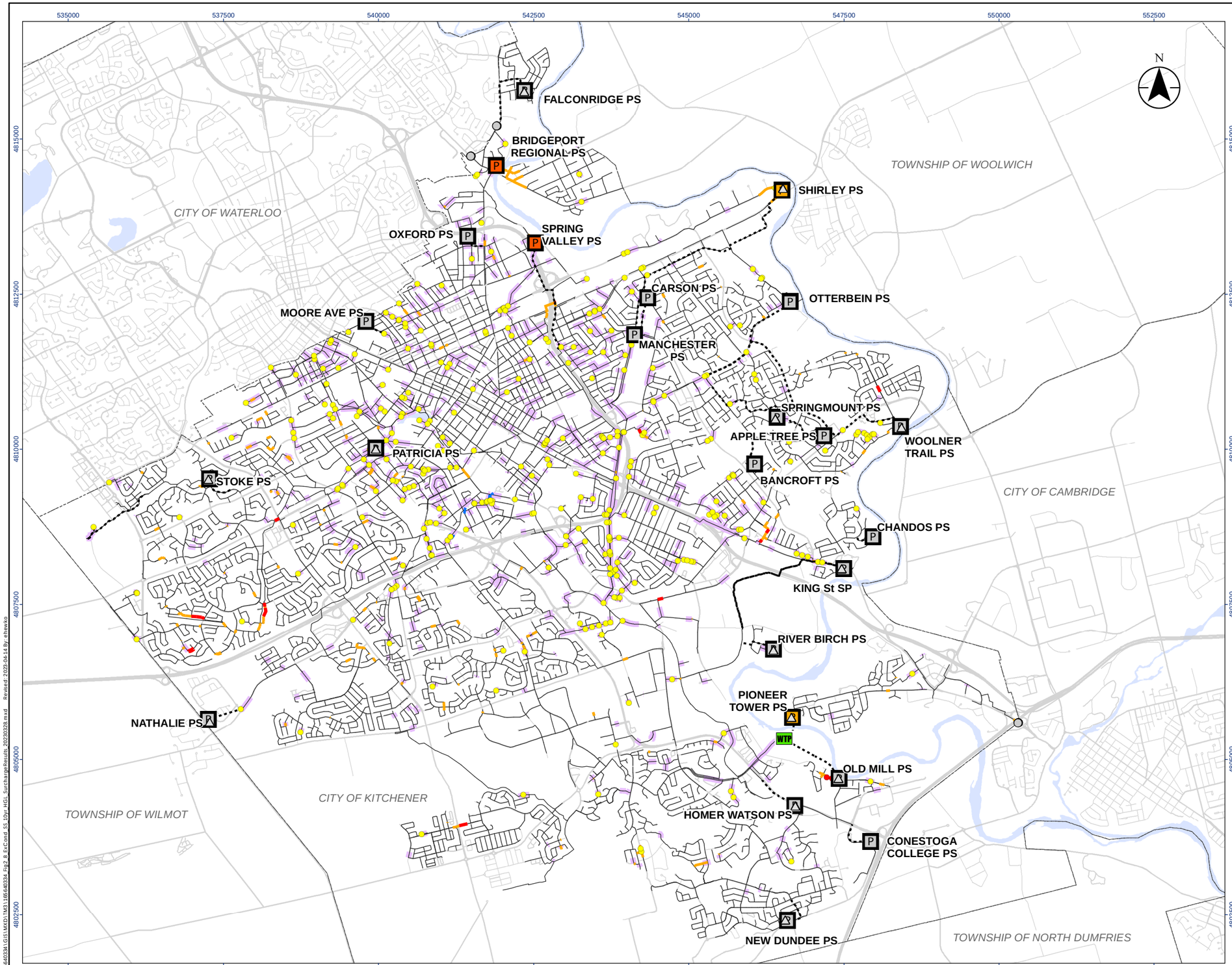
Figure No.
2.7

Title
Existing Conditions Sanitary Sewer System
5-Year HGL & Surcharge Results



Stantec

Legend

- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon
- Shallow Pipes (Obvert <= 1.8m of Surface)

Pumping Station 10yr Flow Results

- PS ECA Exceeded by 10yr Flow
- PS Firm & Rated Capacities Exceeded by 10yr Flow
- PS ECA, Firm & Rated Capacities Exceeded by 10yr Flow
- All Other PSs

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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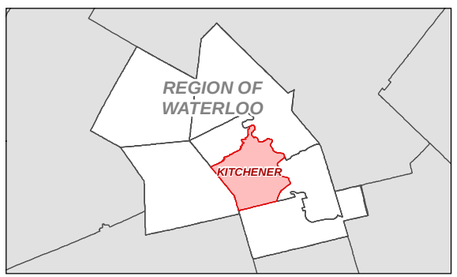

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Figure No.
2.8

Title
Existing Conditions Sanitary Sewer System
10-Year HGL & Surcharge Results

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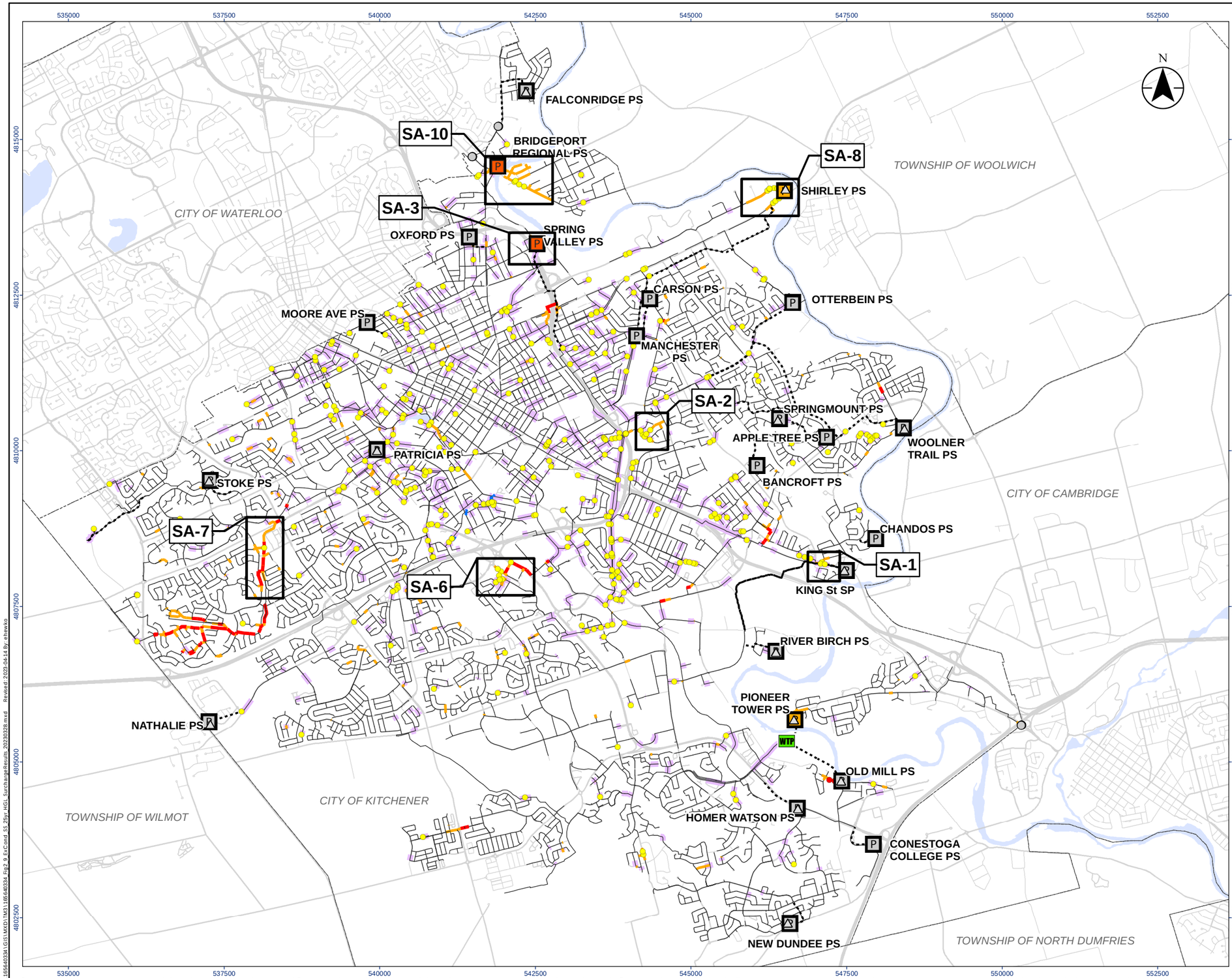

Stantec

Legend

- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon
- Shallow Pipes (Obvert <= 1.8m of Surface)

Pumping Station 25yr Flow Results

- PS ECA Exceeded by 25yr Flow
- PS Firm & Rated Capacities Exceeded by 25yr Flow
- PS ECA, Firm & Rated Capacities Exceeded by 25yr Flow
- All Other PSs

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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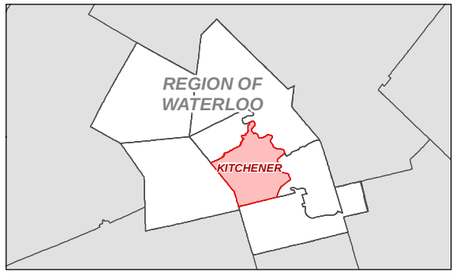

Project Location
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Figure No.
2.9

Title
Existing Conditions Sanitary Sewer System
25-Year HGL & Surcharge Results

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2.2 CONDITION-BASED SYSTEM ASSESSMENT

The City's 2022 asset management data was provided per sewer on December 8th, 2022, in shapefile format (file name: "condition_score_2022.shp") and consisted of Pipe Asset IDs, road segments IDs, install years, material, ownership, age-based scores per sewer, the most recent CCTV inspection year, and condition-based scores per sewer. Additionally, the *Ottawa Street Sanitary Trunk Sewer Condition Assessment and Rehabilitation Recommendation Final Report* by Andrews.Engineer (dated December 2022), was provided on December 21st, 2022, and used to extract up-to-date condition grades for the Ottawa St trunk sewers. This assessment was recently completed due to concerning conditions and H_2S levels within the Ottawa St trunk sewer and had not yet been integrated into the City's asset management database. The City also assesses sanitary sewer risk based on sewer condition and criticality, which is defined by a Total Wastewater Priority Assessment Score (TWPAS), ranging from 0 (no data or low risk and consequence of failure) to 100 (high risk and consequence of failure). Based on the review of this dataset however, it was determined that the most up-to-date CCTV scoring, and criticality assessments had not yet been integrated into the file provided. This process is ongoing but was not anticipated for completion in time for this condition-based system assessment and thus, only the CCTV scoring was compiled and reviewed to determine the need for condition-based asset renewal projects based on existing pipe conditions. The following sub-sections discuss the approach and criteria used to define sewers in poor condition, and the subsequent list of sewers currently in need of asset renewal.

2.2.1 Assessment Approach

The CCTV scores provided in the City's asset management data were used to define sewers in poor condition and thus identify those considered for asset renewal. The following criteria was used to establish this list.

- Provided CCTV score or condition grade (if included in the Ottawa St trunk sewer assessment) of 4 or greater, regardless of when the most recent CCTV assessment was conducted;
- Owned by City of Kitchener, or dually owned by both the City of Kitchener and the Region of Waterloo;
- Not already identified for potential upgrades due to poor capacity-based performance, as per **Table 2-3** of **Section 2.1.5.2** above; and,
- Not already included in near-term (2029 or sooner) trenchless relining projects or share road segment IDs with proposed roadway reconstruction projects, as per the following files provided by the City on December 7th, 2022:
    - "Sanitary trenchless lining 2022.xlsx";
    - "Sanitary trenchless lining 2023.xlsx"; and,
    - "Reconstructions_plan.xlsx".

2.2.2 Assessment Results

The criteria outlined in **Section 2.2.1** was used to establish an inventory of trunk sewers within the City of Kitchener sanitary sewer network currently considered in poor condition based on the provided CCTV scoring and structural grades. A total of 108 gravity sewers were found to fall within these criteria, equating to 7.1 km of sewer length. These sewers are documented in **Table 2-5** by Problem Area, where "AC" refers to Asset Condition. Their general locations within the City are illustrated in **Figure 2-10.**

Table 2-5: Gravity Sewers Currently in Poor Condition

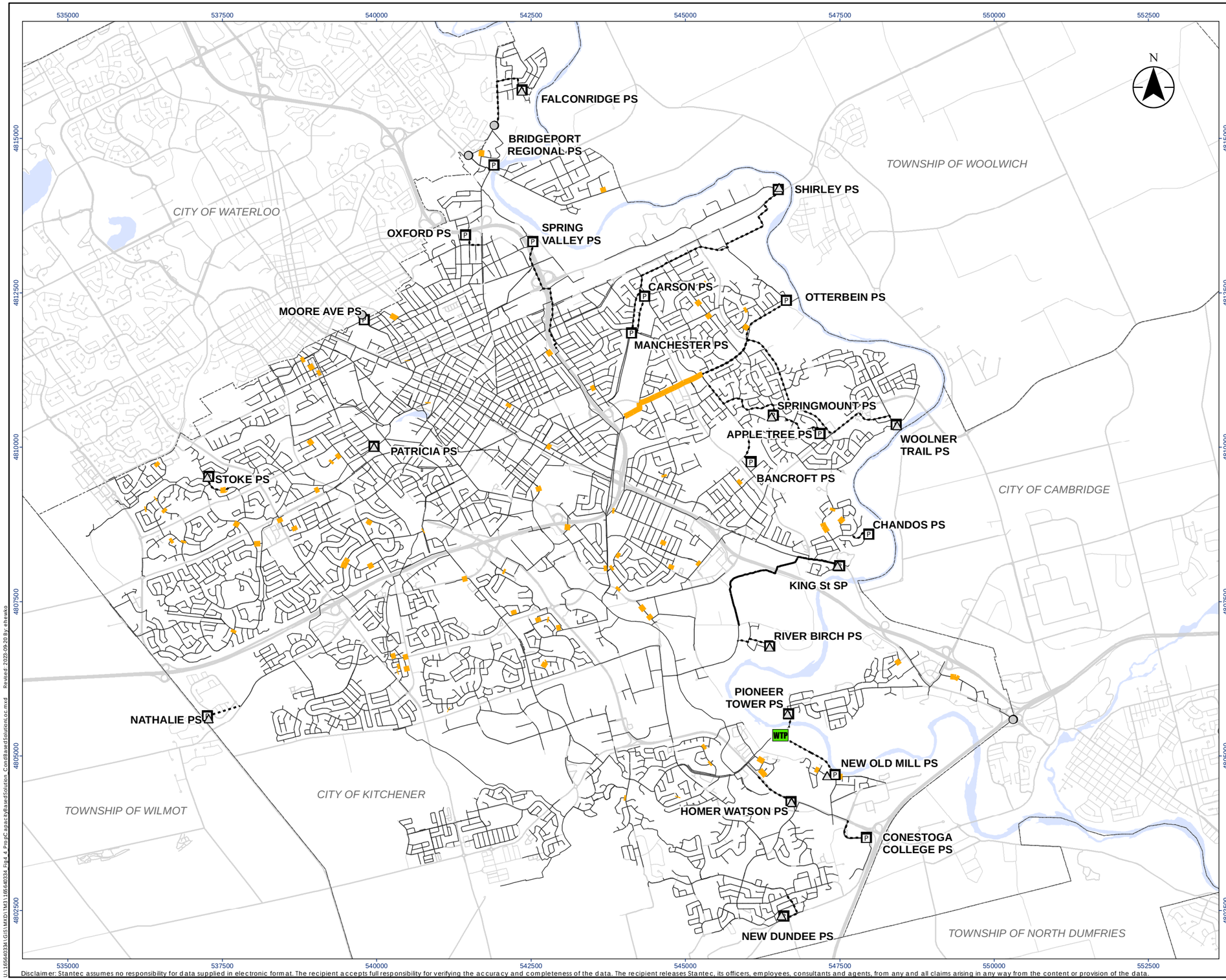
Asset Condition ID	Street Name	Location Description	Pipe Asset IDs
AC-1	Vanier Dr	1x 375 mm sewer through easement between Vanier Dr and Clark Ave	118182
AC-2	Westforest Trl	1x 375 mm sewer between Westmeadow Dr and Hidden Creek Dr	110504
AC-3	Bankside Dr	1x 450 mm sewer between Golden Terrace Crt and Eastforest Trl	109989
AC-4	Ottawa St N, Dreger Ave, Graber Pl	19x 675 mm sewers from Old Chicopee Dr to just upstream of Conestoga Pkwy	101611, 101612, 101613, 101365, 101366, 101367, 101368, 101335, 101339, 101340, 101341, 101342, 101350, 101351, 101352, 101849, 101850, 101851, 101852
AC-5	Greenbrook Dr	2x 375 mm sewers between Birchcliffe Ave to just north of Stonybrook Dr	108404, 108513
AC-6	Greenbrook Dr	Downstream of AC-8; 1x 900 mm sewer within Stirling Ave S intersection	107730
AC-7	Rock Ave	1x 525 mm sewer at the end of Rock Ave through private ICI property located between Belmont Ave W and the throughway behind the ICI buildings	105256
AC-8	West of Connaught Pl	1x 400 mm sewer in easement between Connaught Pl and Conestoga Pkwy	100263
AC-9	Richmond Avenue	1 x 250 mm sewer between Water St S and David St	2002189
AC-10	Huck Crescent	1 x 200 mm sewer between Udvari Crescent and Keller Crescent	119495
AC-11	Highbrook Ct	1 x 200 mm between Fisher-Hallman Rd and Highbrook St	119059

Asset Condition ID	Street Name	Location Description	Pipe Asset IDs
AC-12	Deep Ridge Dr	1 x 200 mm between Candle Crescent and Grand Hill Dr	118447
AC-13	Woolwich St	1 x 200 mm between Hillcrest Ln and Bridle Trail	110889
AC-14	Northmanor Crescent	1 x 200 mm between Resurrection Dr and University Ave W	110709
AC-15	Windward Pl	1 x 250 mm between Keller Crescent and Westforest Trail	110658
AC-16	Westforest Trail	1 x 200 mm between Shadyridge Pl and Beechcroft Pl	110528
AC-17	Dawn Ridge Dr	1 x 200 mm between Westmeadow Dr and Westforest Trail	110522
AC-18	Marlis Crescent	1 x 200 mm between Bleams Rd and Erinbrook Dr	108258
AC-19	Highbrook St	2 x 200 mm on Highbrook St	108216, 108203
AC-20	Block Line Rd	1 x 250 mm between Highbrook St and Westmount Rd E	108196
AC-21	Ristau Crescent	1 x 200 mm between Highbrook Crescent and Dinison Crescent	108056
AC-22	Ottawa St S	1 x 200 mm between McLennan Park Gate and Strasburg Rd	107118
AC-23	Conestoga Pkwy Onramp	1 x 200 mm between Courtland Ave E and Conestoga Pkwy	107094
AC-24	Bedford Rd	2 x 200 mm between Sydney St S and Schneider Creek	106954, 106955
AC-25	Riverbend Dr	1 x 250 mm incoming pipe North of Spring Valley SPS	105863
AC-26	Cameron St N	1 x 200 mm between Duke St E and Weber St E	104745
AC-27	Breithaupt St	1 x 200 mm between Moore Ave and Waterloo St	104435
AC-28	McLeod Ct	1 x 200 mm at the intersection of McLeod Ct and Biehn Dr	103960
AC-29	Gateway Park Dr	3 x 300 mm between Sportsworld Dr and Tu-Lane St	103769, 103770, 103771
AC-30	Brembel St	1 x 200 mm sewer through private residential complex located between Brembel St and Ottawa St N	102507
AC-31	Denlow St	1 x 200 mm between Brembel St and Rose Garden St	102499
AC-32	Alpine Rd	1 x 250 mm between Kingswood Dr and Homer Watson Blvd	118286

Asset Condition ID	Street Name	Location Description	Pipe Asset IDs
AC-33	Hollinger Crescent	1 x 250 mm between Bridge St E and Dumart Pl	111001
AC-34	Stoke Dr	1 x 200 mm between Wexford Crescent and Monarch Woods	110577
AC-35	Driftwood Dr	1 x 200 mm between Parkland Crescent and Toynbee Crescent	109901
AC-36	Fisher-Hallman Rd	1 x 250 mm between Highland Rd W and Queen's Blvd	108906
AC-37	Westheights Dr	1 x 300 mm sewer through private property located on Westheights Dr	108878
AC-38	Overlea Dr	1 x 250 mm sewer at the intersection of Overlea Dr and Overlea Crescent	108477
AC-39	Stonybrook Dr	1 x 225 mm sewer between Village Crescent and Sweetbriar Dr	108398
AC-40	Barberry Pl	1 x 225 mm sewer between Westmount Rd and Forest Hill Dr	108347
AC-41	Sandsprings Crescent	2 x 200 mm sewer between Devonglen Dr and Sandsprings Ct	107604, 107656
AC-42	Cherry Hill Dr	1 x 250 mm sewer between Coach Hill Dr and Murrayhill Ct	107321
AC-43	Coach Hill Dr	1 x 250 mm sewer between Cherry Hill Dr and Block Line Rd	107318
AC-44	Coach Hill Dr	1 x 250 mm sewer between Cherry Hill Dr and Homer Watson Blvd	107306
AC-45	Selkirk Ct	1 x 200 mm sewer between Selkirk Dr and Geneva Crescent	107224
AC-46	Highland Crescent	1 x 250 mm sewer between Highland Rd and Westmount Rd	106442
AC-47	Paulander Dr	2 x 250 mm sewer between Victoria St S and Lawrence Ave	106329, 106334
AC-48	Weichel St	1 x 250 mm sewer between Belton Dr and Karn St	106299
AC-49	Belmont Ln W	1 x 250 mm sewer between Claremont Ave and Argyle St	106083
AC-50	Union Blvd	1 x 250 mm sewer between Earl St and Severn Ave	106063
AC-51	Guelph St	1 x 250 mm sewer parallel to the Spur Line Trail and connect to Guelph St sewer	105106
AC-52	Wheatfield Crescent	1 x 200 mm sewer between Pathfinder Crescent and Bechtel Dr	103885

Asset Condition ID	Street Name	Location Description	Pipe Asset IDs
AC-53	Manitou Dr	2 x 250 mm sewer between Fairway Rd S and Webster Rd	103436, 100040
AC-54	Upper Canada Dr	1 x 250 mm sewer through private residential property located between Farrier Dr and Upper Canada Dr	103415
AC-55	Old Mill Rd	1 x 300 mm sewer between Sydenham St and Pinnacle Dr	103117
AC-56	Old Mill Rd	1 x 200 mm sewer between Mill Park Dr and Rose St	103108
AC-57	Arrowhead Crescent	2 x 250 mm sewer between Homer Watson Blvd and Green Valley Dr	103052, 103053
AC-58	Green Valley Dr	1 x 250 mm sewer between Pioneer Dr and Arrowhead Crescent	103041
AC-59	Lower Canada Crescent	1 x 250 mm sewer at the intersection of Lower Canada Crescent and Upper Canada Dr	102928
AC-60	Dumfries Ave	1 x 225 mm sewer between Chapel St and Krug St	102355
AC-61	Heritage Dr	1 x 200 mm sewer between Lorraine Ave and Oakhurst Crescent	102231
AC-62	Heritage Dr	1 x 250 mm sewer between Keewatin Ave and Lorraine Ave	102226
AC-63	Nipigon St	1 x 250 mm sewer between Nipigon Pl and Georgian St	102207
AC-64	Burbank Rd	1 x 200 mm sewer between Conestoga Pkwy and Ada St	101738
AC-65	King St E	1 x 200 mm sewer between Sydney St S and Ottawa St S	101278
AC-66	Wyandotte Ct	1 x 250 mm sewer in Morrison Park between Wyandotte Ct and Oneida Pl	100995
AC-67	Morrison Road	1 x 250 mm sewer between Quinte Crescent and Grand River Blvd	100981
AC-68	Morrison Road	2 x 200 mm sewer between mm sewer between Quinte Crescent and Grand River Blvd	100972, 100973
AC-69	Burgetz Ave	1 x 250 mm sewer between River Rd E and Thaler Ave	100921
AC-70	Broadview Ave	1 x 250 mm sewer between Broadview Ct and Shuh Ave	100776
AC-71	Siebert Ave / Courtland Ave E	1 x 250 mm sewer at the intersection of Siebert Ave and Courtland Ave E	100628

Asset Condition ID	Street Name	Location Description	Pipe Asset IDs
AC-72	Greenfield Ave	1 x 250 mm sewer at the intersection of Greenfield Ave and Kingsway Dr	100602
AC-73	Broadmoor Ave	1 x 200 mm sewer at the intersection of Broadmoor Ave and Clark Ave	100324
AC-74	Hillmount St	1 x 250 mm sewer at the intersection of Hillmount St and Shelley Dr	100304
AC-75	Carrol St	1 x 250 mm sewer between Connaught St and Greenfield Ave	100146
AC-76	Traynor Ave	1 x 250 mm sewer at the intersection of Wilson Ave and Traynor Ave	100075
AC-77	Hazen Glen Dr / Ingleside Dr	2 x 250 mm sewer on Hazen Glen Dr and Ingleside Dr	110736, 110759
AC-78	Union St	2 x 225 mm sewer on Union St	104911, 106005



Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Other Sewers
- Forcemain
- Gravity Sewers Currently in Poor Condition

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Notes

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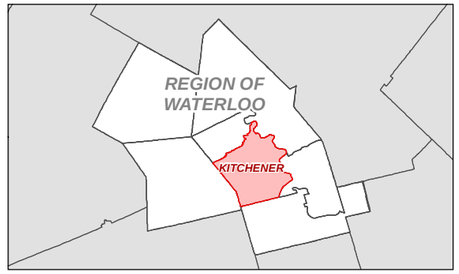


Project Location
City of Kitchener

165640334 REVA
Prepared by EH on 2023-09-20

Client/Project
CITY OF KITCHENER
INTEGRATED SANITARY MASTER PLAN

Figure No.
2.10

Title
Gravity Sewers Currently in Poor Condition

2.3 SANITARY SEWER SYSTEM DATA COLLECTION AND MANAGEMENT PROGRAMS

With the data review and capacity- and condition-based system performance assessments completed as part of this Integrated Sanitary Master Plan, Stantec has gained an understanding of the current ongoing programs underway for the City of Kitchener's sanitary sewer system data collection and management and has identified some gaps that could be filled to help improve the understanding and operation of the system.

The City of Kitchener has ongoing or recent programs that help to compile current asset condition data, estimate inflow and infiltration (I/I) within the sanitary sewer system, collect rainfall and flow monitoring data, and update and maintain their sanitary sewer hydraulic model. These programs are further discussed in the following sub-sections.

2.3.1 Sanitary System Condition Data Acquisition and Management

The City has an ongoing CCTV program where data inspections are conducted throughout each year with the intent of maintaining a GIS database of up-to-date data for the entire sanitary sewer system. Based on the size of this system, CCTV inspections are typically carried out for each pipe every 10 to 20 years. Trunk sewers tend to be inspected less frequently due to the constant, large flows observed in the pipe and the associated difficulties with CCTV inspections. Forcemains typically do not undergo CCTV inspections due to their pressurized state. If a second forcemain exists at the pumping station, then flow can be diverted to the other forcemain allowing for the inspection of the first; however, most pumping stations within the City of Kitchener have only a single forcemain. There are new, innovative methodologies available for inspecting forcemains, such as the SmartBall technology, which consists of a tethered inspection tool that travels with the flow of the pipe while simultaneously collecting data. This technology can be used to understand pipe condition, detect leaks, and validate existing GIS data, and is further discussed in **Section 4.4.1**.

Similar to the condition-based system assessment data review described in **Section 2.2**, the City's 2022 asset management data was used to assess the relevance of the compiled CCTV data per pipe. As noted in the above-referenced section, this dataset was updated with the information obtained from Andrew Engineer's 2022 Ottawa Street Trunk Sewer report. Based on the pipe age and how recent the latest CCTV data acquisition occurred, the sanitary sewers were categorized by their need for updated data collection. Sewers qualified for this categorization based on the following criteria.

- Provided CCTV score or condition grade (if included in the Ottawa St trunk sewer assessment) of less than 4;
- Owned by City of Kitchener, or dually owned by both the City of Kitchener and the Region of Waterloo;
- Not already identified for potential upgrades due to poor capacity-based performance or condition-based performance, as per **Table 2-3** and **Table 2-5** of **Sections 2.1.5.2** and **2.2.2** above, respectively; and,

- Not already included in near-term (2029 or sooner) trenchless relining projects or share road segment IDs with proposed roadway reconstruction projects, as per the following files provided by the City on December 7th, 2022:
    - "Sanitary trenchless lining 2022.xlsx";
    - "Sanitary trenchless lining 2023.xlsx"; and,
    - "Reconstructions_plan.xlsx".

From the provided dataset, a total of 1,888 pipes (140.9 km) including forcemains, qualified for the categorization of CCTV data relevance based on these criteria. In the future, the updated TWPAS scores can also be used in conjunction with or instead of the CCTV scoring and pipe age. The following categories were then applied based on pipe age and recency of the latest CCTV data acquisition. A threshold of 6 years was used to classify CCTV data as recent or outdated, as this would result in 10-year-old data by the end of a 4-year term, at which point the City would reassess program budgets.

- **Outdated CCTV and is considered most critical:** Pipe age is 25 years or older (or unknown), and the last CCTV data collection was conducted 6 or more years ago (or unknown);
- **Outdated CCTV and is considered medium criticality:** Pipe age is 25 years or older (or unknown) and the last CCTV data collection was conducted within the last 5 years, OR pipe age is between 6 and 24 years and the last CCTV data collection was conducted 6 or more years ago (or unknown); and,
- **Outdated CCTV and is considered less critical:** Pipe age is between 6 and 24 years and the last CCTV data collection occurred within the last 5 years, OR pipe age is 5 years or less.

The following **Table 2-6** summarizes the quantity and length of sewer falling within each of these categories. The location of these sewers is presented in **Figure 2-12**.

Table 2-6: CCTV Data Relevance

Category	Sewer Type	Quantity of Sewers	Sewer Length (km)
Outdated CCTV – Most Critical	Gravity	919	66.7
	Forcemain	9	6.7
Outdated CCTV – Medium Criticality	Gravity	705	43.3
	Forcemain	14	10.5
Outdated CCTV – Less Critical	Gravity	239	13.4
	Forcemain	2	0.4
Subtotals	Gravity	1,863	123.4
	Forcemain	25	17.5
Total	Gravity & Forcemain	1,888	140.9

2.3.2 Sewer Flushing

Sewer flushing programs are conducted each year to reduce the amount of sedimentation or debris buildup within the system. Certain sewers require cyclical flushing and have been deemed by the City as "hot spots". Hot spots may occur due to pipe condition or poor hydraulics or low flows resulting in unattained scour velocities. A total of 424 pipes are identified as hot spots as of 2022, as per the spreadsheet titled "cyclical_2022.xlsx" provided on December 21, 2022. Depending on the frequency of buildup and criticality of the sewer, flushing cycles ranges from every month to once a year. The number of pipes per cycle duration is illustrated in **Figure 2-11**, while the locations of these hot spots is shown in **Figure 2-12**. From the provided list, 2 IDs were not found in the received GIS or model data, including 2119659 and 107718, and are thus not rendered in **Figure 2-12**.

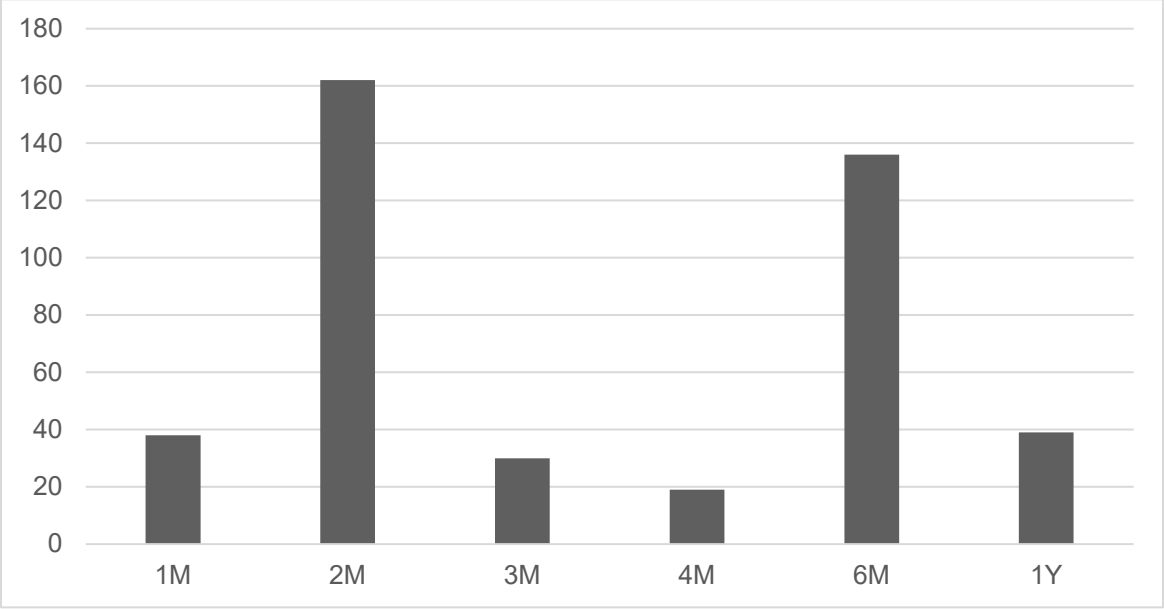
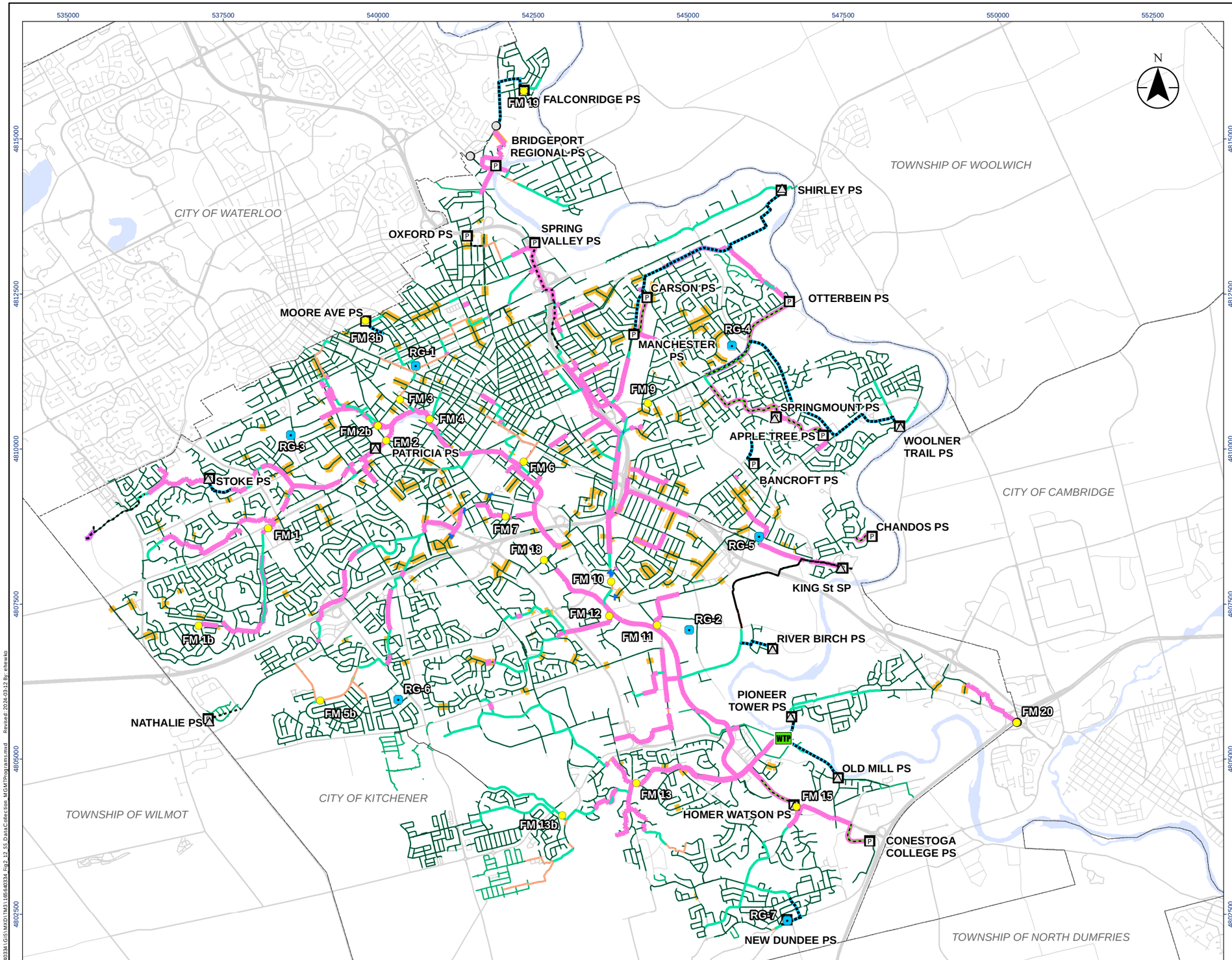


Figure 2-11: Number of Hot Spots per Flushing Cycle



Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Other Sewers
- Forcemain
- Siphon
- Rain Gauge Location
- Flow Monitor Location
- Hot Spot Cyclical Flushing

Outdated Conditions Criticality Level

- Gravity Pipe Most Critical
- Gravity Pipe Medium Criticality
- Gravity Pipe Less Critical
- Forcemain Less Critical
- Forcemain Medium Criticality
- Forcemain Most Critical

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Notes

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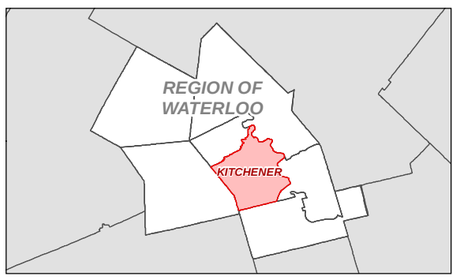


Project Location
City of Kitchener

165640334 REVA
Prepared by EH on 2024-03-12

Client/Project
CITY OF KITCHENER
INTEGRATED SANITARY MASTER PLAN

Figure No.
2.12

DRAFT

Title
Current Sanitary Sewer System Data Collection and Management Programs

2.3.3 Infiltration/Inflow Estimation

The City estimates the amount of Inflow and Infiltration (I/I) entering the sanitary sewer system monthly and annually using a high-level calculation approach, where the estimated total volume of sewage considered "exiting" the Kitchener sewer system (treated at the WWTP or pumped to Waterloo from the Bridgeport SPS) is compared to the estimated volume of sewage generated based on collection fees paid by residents. The difference is assumed to represent the amount of I/I entering the sanitary sewer system. The City's analysis spreadsheet (titled *Sewer Water Comparison.xlsx* on September 21, 2021) was provided as part of this Integrated Sanitary Master Plan. The approach was reviewed and is summarized below.

- Total Retail Sewage Volume (TRSV) is estimated based on the amount paid by residents, divided by the cost per cubic meter:
    - TRSV (m^3) = Total Sewage Cost ($) / Unit Cost ($/m^3);
- Total Treated Sewage Volume (TTSV) treated at the WWTP is provided by the Region (m^3);
- Total Pumped Sewage Volume (TPSV) leaving the system via the Bridgeport SPS is provided by the Region (assumed 41% of total value provided) (m^3);
- Total I/I Volume (TIIV) is then estimated by adding the volumes treated or leaving the system via Bridgeport SPS and subtracting the Total Retail Sewage Volume
    - TIIV (m^3) = TTSV (m^3) + TPSV (m^3) – TRSV (m^3)
- The percentage of infiltration is then calculated:
    - % I/I = TIIV (m^3) / (TTSV + TPSV) (m^3)

From January to July of 2021, this approach resulted in a range of 3.2% to 31.6% of sewage flows attributed to I/I entering the system each month with a 7-month average of 16.1%, as per the provided spreadsheet (data for the remaining months of 2021 was not provided). Since the amount of sewage collected is not metered but rather estimated based on a percentage of potable water consumed, this approach only provides a very high-level approximation of I/I within the system. It is also unknown whether it accounts for sewage flows that ultimately exit the system through Cambridge or Falconridge.

I/I is better estimated using flow monitoring data and model calibration, as completed as part of this Master Plan. The calibrated dry weather flow (DWF) groundwater infiltration (GWI) and wet weather flow (WWF) Total R, or volumetric runoff coefficient (%), suggest lower amounts of I/I entering the system within monitored areas. Volumetric runoff coefficients represent the volume of rainfall falling within the metershed that is captured and conveyed by the sewer system via inflow and infiltration sources, such as roof, foundation drains or catchbasin connections, inflow through maintenance hole covers (including perforated covers) as well as increased infiltration due to rainfall through leaky systems or joints.

An average GWI rate of 0.029 L/s/ha is established for the areas draining to the Bridgeport SPS and the WWTP (representative of the contributing areas assessed as part of the City's I/I estimation), comprising 15.4% of the peak DWF exiting the system at these locations. This percentage it is only representative of the DWF portion of I/I and does not account for WWF I/I, as the I/I estimation analysis does. The WWF I/I is represented by the average volumetric runoff coefficient of 2.5% for the same contributing areas identified from the calibrated parameters. Neither the GWI rate or volumetric runoff coefficient parameters suggest high I/I within the system.

2.3.4 Rainfall and Flow Monitoring

Rainfall and flow monitoring programs are typically conducted within the City of Kitchener as part of sanitary sewer system hydraulic model updates, calibration and system performance assessment projects. The City maintains and operates two (2) permanent rain gauges (City Hall and Kitchener Operations Facility), and has no permanent flow monitors.

As part of the previous model update completed by AECOM in 2019, 15 temporary flow monitors were installed for a 3-month monitoring program from June to September of 2016, along with 5 additional temporary rain gauges. This data was used to calibrate and assess the system, forming the content of AECOM's *City of Kitchener Sanitary Sewer Model Update Final Report*, submitted December 12, 2019.

In 2021, the City engaged Stantec to complete this Integrated Sanitary Master Plan (ISAN-MP), which required a new rainfall and flow monitoring program to obtain more up-to-date data with which to re-calibrate the model. A total of 20 temporary flow monitors and 5 temporary rain gauges were installed for another 3-month monitoring program from August to November of 2021. The locations of these meters and gauges can be found in **Figure 2-12**. Details of this program can be found in the ISAN-MP's **TM2 Sections 5.0** and **6.0**. The resulting calibration is documented in **Section 7.0** of that same TM.

2.3.5 Sanitary Hydraulic Model Updates & Maintenance

The all-pipe sanitary sewer system hydraulic model was originally developed in 2010 using Innovyze's InfoSWMM modelling software. This model was updated by AECOM using 2016 rainfall and flow monitoring data and incorporated infrastructure updates that had occurred since the original model development, as discussed in **Section 2.3.4**. AECOM's *City of Kitchener Sanitary Sewer Model Update Final Report* (2021) documents this process and the yielded system assessment results. It also recommends the City implement a survey program to obtain maintenance hole and pumping station data and improve the collection of pumping station SCADA data to fill in missing or erroneous data gaps observed.

Between 2019 and 2021, the City initiated the condition-based assessment of all City-owned sanitary pumping stations within Kitchener. R.J. Burnside & Associates Limited conducted these assessments and provided a Condition Assessment Report (CAR) for each station, which included the review of the pumping station's ECAs, wet well details, pumping station configurations, and in many cases, current pump capacities via drawdown tests.

SCADA systems have been installed at all City-owned pumping stations, which collect wet well levels and pump ON/OFFs. This data can be relatively helpful in validating pumping station operation in the model, however, this information in conjunction with influent and discharge metering can provide a more accurate depiction of the pumping station operation for use in model validation.

The City then engaged Stantec in 2021 to complete this ISAN-MP and perform another model infrastructure update and calibration. Through discussions with the City and to be consistent with the City's stormwater model, the InfoSWMM hydraulic model was converted to Innovyze's InfoWorks ICM. ICM offers excellent data management and documentation options as well as robust engineering validation tools and queries that help to improve the quality of the model and results. The conversion of the InfoSWMM model into ICM however, identified substantial instabilities and engineering validation concerns, including hundreds of inconsistent profiles where downstream sewers were higher in elevation than upstream sewers, or in many cases, even found to be above ground. Many of these inconsistencies required resolution in order to stabilize the model enough to allow for successful simulations with limited instabilities and data spikes. These issues were resolved predominantly using inference due to the magnitude of inconsistencies observed. This assessment and the necessary fixes are documented in **Section 4.1.1** of the ISAN-MP's **TM2**. Once resolved, model updates were completed to integrate new infrastructure and upgrades undertaken between 2016 and 2021 based on the provided GIS data and Condition Assessment Reports. Calibration was then completed and documented in **TM2**.

The process of rainfall and flow monitoring, maintenance hole surveying and GIS database updates, pumping station SCADA data collection, and model updates and recalibration should be undertaken in regular intervals to best understand and preventatively identify system deficiencies.

3.0 FUTURE CONDITIONS

The calibrated model detailed in TM2 is used as the basis of the future conditions system assessment and capacity-based solution development. Future conditions scenarios include the 2031 and 2051 horizons where growth is observed to occur as infill, intensification, and new developments. **Section 3.1** documents the infrastructure and flow updates completed for these scenarios.

No additional condition-based system assessment was completed for future conditions, as poor conditions cannot be accurately predicted based on current pipe condition. The current programs and program gaps discussed in **Section 2.3** remain applicable for future conditions.

3.1 MODEL UPDATES AND CAPACITY-BASED SYSTEM ASSESSMENT

The flow generation parameters for existing producers are maintained in future conditions. Parameters applied to areas of growth are described in **Section 3.1.1**. The boundary conditions applied in the existing conditions model are maintained for future conditions.

Infrastructure updates used in the model to assess the 2031 and 2051 future conditions sanitary sewer system from a capacity perspective are outlined in **Sections 3.1.2** and **3.1.4**, respectively. The resulting 2031 and 2051 capacity-based system performance based on the 25-year, 12-hr AES design storm event for sewers and the 10-year, 12-hr AES design event for pumping stations is discussed and illustrated in **Section 3.1.3** and **3.1.5**, respectively.

3.1.1 Future Conditions Flow Generation Parameters

The flow generation approach differs for infill, intensification, and new developments, as discussed in **TM2**. Calibrated DWF and WWF parameters from metersheds with either predominately residential or ICI characteristics were used in the future conditions flow generation, based on the type of growth anticipated. **Table 3-1** outlines the flow generation parameters applied for infill, intensification, and new development growth in the 2031 and 2051 scenarios.

Table 3-1: Infill, Intensification and New Development Flow Generation Parameters by Land Type

Growth Type	Land Use Type	Applicable FM Metershed	Land Use	FM Per Capita (L/cap/d)	Wastewater Profile[1]	GWI Rate (L/s/ha)	RTK Hydrograph[2]	Total R (%)
Infill & Intensification	Residential	FM13b	98% RES	225	16	N/A	N/A	N/A
	ICI	FM20	99% ICI	232	20	N/A	N/A	N/A

Growth Type	Land Use Type	Applicable FM Metershed	Land Use	FM Per Capita (L/cap/d)	Wastewater Profile[1]	GWI Rate (L/s/ha)	RTK Hydrograph[2]	Total R (%)
New Developments	Residential	FM13b	98% RES	225	16	0.022	New-RES(FM13b)	1.04%
	ICI	FM20	99% ICI	232	20	0.026	New-ICI(FM20)	1.11%

NOTES:

1. Wastewater profile defines the per capita rate, and weekend and weekday diurnal patterns applicable to the flow metershed. See **Appendix F** of **TM2** for the applicable diurnal patterns.
2. RTK Hydrograph defines the R, T and K values used to generate RDII. See **Appendix F** of **TM2** for the applicable RTKs.

3.1.2 2031 Horizon Growth and Infrastructure Updates

The 2031 flow generation, boundary conditions, and infrastructure updates were applied as outlined in **Section 8.2.3** of **TM2**.

This includes increasing the total serviced population to approximately 589K from 339K in existing conditions based on the 50% build-out populations provided in the City's Parcel-People-Jobs (PPJ) file. Notably, this population forecast is greater than the actual population forecast for the City as a whole and is a result of over estimating individual growth areas in order to provide a level of conservatism in the growth forecasts. While growth forecasting for the City as a whole is considered relatively accurate, the location of that growth is more difficult to forecast and thus the data provided by the City accounts for some uncertainty as to the location of growth.

Additionally, the 2031 scenario incorporates the replacement of the Old Mill SPS with the New Old Mill SPS; the decommissioning of the Moore SPS and substitution for gravity conveyance to the Waterloo sewer system; as well as upgrades that are proposed at the Otterbein SPS and Spring Valley SPS. The Moore SPS is anticipated for decommissioning based on recent planning discussions between the City of Kitchener and the City of Waterloo. It requires the abandonment of the current pumping station, forcemain, and overflow through the adjacent Kitchener Mount Hope Cemetery lands, and redirection of flows through a new gravity sewer on Moore Ave draining north into the Waterloo sanitary sewer system. The Environmental Assessment study reports (EAs) for Otterbein and Spring Valley were provided and used to obtain the future conditions' capacities. All other pumping station setups are maintained from the existing conditions scenario. **Table 3-2** outlines the pumping station updates made for the 2031 scenario.

The City has indicated the potential for growth in the Hidden Valley area and noted the probable River Road extension. To represent the proposed development in this area, the parcels with population growth as determined from the provided PPJ file are not included in the model and are instead represented by a constant inflow of 91 L/s into the upstream end of the Wabanaki Trunk Sewer equivalent to the proposed peak flow rate outlined in the *Upper Hidden Valley Sanitary Pump Station and Forcemain Environmental Assessment (EA)* prepared by MTE Consultants Inc., dated May 25, 2022. The timeline of which has not been confirmed but is assumed for the 2031 and 2051 scenarios.

Diameter information (no inverts) for the proposed upgrades along the *Wabanaki Trunk Sewer as per the Wabanaki Trunk Sewer Downstream Capacity Technical Memorandum* by MTE Consultants Inc., dated January 5th, 2023, were provided after the completion of the future condition's performance assessment and solution development. Thus, they are not included in the 2031 and 2051 scenarios at this time. The flows observed in the 2051 scenario, however, do not result in capacity constraints along the existing Wabanaki trunk infrastructure. The upgrades are likely proposed based on ultimate conditions, which are not achieved in the horizons assessed as part of this MP.

The proposed East Side Lands development was also reviewed for potential inclusion in the future conditions modelled. As per the *Region of Waterloo East Side Lands Sanitary Servicing Class Environmental Assessment Environmental Study Report* by Associated Engineering and dated November 2018, the recommended alternative includes installing a pumping station within the area and that directs the flows straight to the WWTP. This is not anticipated to interfere with the existing or proposed infrastructure capacity and thus, is not considered further.

The Biehn Drive sanitary trunk sewer extension is also not included in the future conditions modelling due to limited impact. The growth in this area is assumed accounted for in the provided PPJ file and allocated to the proposed trunk sewer extension connection point, as per the *Biehn Drive Sanitary Trunk Sewer Extension Sanitary Sewer Pre-design Technical Memorandum* by Sanchez Engineering Inc, dated October 26, 2021.

Table 3-2: 2031 Updated Pumping Station Firm & Rated Capacities Based on Theoretical Operation

Pumping Station	Firm Capacity (L/s)	Rated Capacity (L/s)	Rated Capacity Pump Operation	ECA Firm Capacity (L/s)	Additional Notes
Old Mill SPS	N/A	N/A	N/A	N/A	Decommissioned
New Old Mill SPS	150.0	150.0	2 Duty ON; 1 Standby OFF	Not Available	The firm capacity and pump/system curves are not provided in the Process Control Narrative (PCN); assume equivalent to rated capacity denoted in PCN ECA not yet available
Moore SPS	N/A	N/A	N/A	N/A	To be decommissioned; Flows redirected via new gravity sewer north on Moore Ave to Waterloo sanitary sewer system
Otterbein SPS	165.0	165.0	Unknown	165.0	EA for proposed upgrades provided; notes 165 L/s design capacity

Pumping Station	Firm Capacity (L/s)	Rated Capacity (L/s)	Rated Capacity Pump Operation	ECA Firm Capacity (L/s)	Additional Notes
Spring Valley SPS	350.0	350.0	Unknown	245.0	Currently in design process to provide a near-term upgrade to SPS, increasing capacity to 350 L/s ECA to be updated with upgrades; current ECA allows for 245 L/s

Provisional additions to the pumping stations noted in their ECAs are considered when evaluating solutions, if applicable.

3.1.3 2031 Capacity-Based System Performance

The approach to the future conditions system assessment and criteria is consistent with that of the existing conditions system assessment, as described in **Section 2.1.5.1**. **Figure 3-1**, **Figure 3-2**, **Figure 3-3**, and **Figure 3-4** illustrate the modelled 2031 scenario HGL and surcharge results for the DWF, 5-year, 10-year, and 25-year events, respectively, and are presented with rendering as discussed in **Section 2.1.5.2**.

Based on the presented modelling results, no capacity constraints resulting in HGL issues are observed in the DWF conditions. Excluding siphons, forcemains or remaining inconsistent profiles, there are now five (5) locations where the pipes were found to be 85% full or greater in DWF conditions. Two (2) of these locations are consistent with those observed in existing conditions (as described in **Section 2.1.5.2**), while the remaining three (3) are described below. All five locations are not considered concerns with respect to capacity constraints in the system and do not result in HGL issues in the 25-year event.

- **Three pipes (1x 300 mm diameter, 2x 200 mm diameter) along Seabrook Dr at Fischer Hallman Rd.** Pipe running 85% full or greater due to a drop in pipe sizes from the 300 mm to 200 mm pipes. The next downstream pipe is a 300 mm diameter. Asset IDs include 2098781, 121209, and 121212;
- **One twinned 200 mm pipe (Asset ID 2083719) along Robert Ferrie Dr just east of Southridge Dr.** Due to a drop in pipe size from 375 mm to 200 mm on the main line (immediately draining to a single 375 mm pipe); and,
- **One 600 mm pipe (Asset ID 103273) that connects the Manitou Dr sewers to the Lower Schneider trunk via Wabanaki Dr.** Due to downstream trunk water level and connecting invert.

In the model, there are a total of 13,825 pipes. Among these, 2,088 pipes are classified as trunk sewers. These trunk sewers are defined as gravity pipes with diameters of 375 mm or larger, forcemains, and additional smaller pipes that connect these sewers to form the system's spinal network, as per consultations with the City. Approximately 81.2% (11,232 pipes), experience maximum velocities less than 0.6 m/s under DWF conditions. When examining solely the trunk sewers under DWF conditions, approximately 40.1% experience maximum velocities less than 0.6 m/s.

Similar to DWF conditions, no capacity constraints resulting in HGL issues are observed in the 5-year storm event, other than the area upstream of the Shirley SPS and Dalewood Dr, which are discussed further below. There are nine (9) locations that experience pipes 85% full or greater during this event due to sewer capacity constraints (including the area upstream of Shirley SPS and on Dalewood Dr); three (3) of which see HGL issues in the 25-year event and are described below. The remaining six (6) locations are not considered a concern as HGL issues are not generated by these capacity constraints in the 25-year design event.

- **Dalewood**, 250 mm sewers experience backwater during the 5-year event and surcharging and HGL issues in the 5- and 25-year events. This location is defined as an existing conditions problem area (SA-2);
- **Upstream of Shirley SPS**, HGL and surcharge issues are experienced in the 525 mm sewers in the 5- and 25-year events. This location is defined as an existing conditions problem area (SA-8);
- **Upstream of Bridgeport SPS**, 450 mm and 525 mm sewers experience backwater during the 5-year. HGL and surcharge issues are experienced in the 450 mm sewers in the 25-year events. This location is defined as an existing conditions problem area (SA-10).

In the 25-year design event, one additional Problem Area (areas of observed sewer capacity constraints) is identified within the 2031 future conditions system. This area, in addition to those identified in existing conditions, is highlighted in **Figure 3-4** and described (**bolded**) in **Table 3-3**. Note that while this new problem area (SA-16) is identified in the figure, there are no HGL issues shown. This is because this problem area arises only when the upstream New Dundee SPS capacity is increased as part of solution development.

Figure 3-4 only shows the modelled results excluding solutions and thus, this is not evident. This area is however, accounted for in the problem area list, as it does require solutions. All other areas with HGL issues observed are representative of shallow sewers, or inconsistent profiles in local areas deemed to have minimal impact to the Master Plan.

Table 3-3: 2031 Future Conditions Sanitary Sewer Problem Areas

Problem Area ID	Applicable Scenario(s)	Location	Capacity Constraint Description
SA-1 Upstream of King St SPS	Existing 2031	King St, east of River Rd E	HGLs within 1.8 m of surface due to undersized pipes. Low risk of basement flooding as no building connections are anticipated along these sewers.
SA-2 Dalewood	Existing 2031	Dalewood Dr and Penrose Ave	Risk of basement flooding (HGLs within 1.8 m of surface) due to undersized pipes along Dalewood Dr.
SA-3 Upstream of Spring Valley SPS	Existing 2031	Spring Valley SPS off of Riverbend Dr	HGLs within 1.8 m of surface due to downstream capacity constraints at the Spring Valley SPS. Low risk of basement flooding as no building connections are anticipated along these sewers.

Problem Area ID	Applicable Scenario(s)	Location	Capacity Constraint Description
SA-6 Homer Watson	Existing 2031	Homer Watson Blvd	Risk of basement flooding along Kingswood Dr and Flint Dr due to undersized pipes within the private ICI property and on Homer Watson Blvd. HGLs within 1.8 m of surface on Alpine Rd and Homer Watson Blvd with low risk of basement flooding as no building connections are anticipated along these sewers.
SA-7 Sandrock Trunk	Existing 2031	Highland Rd W and Fischer-Hallman Rd	HGLs within 1.8 m of surface due to undersized pipes along Highland Rd W. Low risk of basement flooding as no building connections are anticipated along these sewers.
SA-8 Upstream of Shirley SPS	Existing 2031	Shirley Dr and Victoria St N	Risk of basement flooding and surface flooding along Shirley Dr due to downstream capacity constraints at the Shirley SPS. HGLs within 1.8 m of surface on Victoria St N with low risk of basement flooding as no building connections are anticipated along these sewers.
SA-10 Upstream of Bridgeport SPS	Existing 2031	Bridge St E between Bloomingdale Rd and Grand Ave	Risk of basement flooding on Bridge St E due to downstream capacity constraints at the Bridgeport SPS. Risk of PS flooding.
SA-16 **Downstream of New Dundee SPS**	**2031**	**Robert Ferrie Dr**	**Risk of basement flooding along Mossgrove Dr and Monarch Woods Dr due to undersized pipes on Robert Ferrie Dr.**

Additionally, the 10-year incoming peak flows are compared to the pumping station's firm, rated and ECA capacities to determine performance or approval issues. The following **Table 3-4** presents these results, along with the 25-year peak incoming flows for reference. The ECA, firm and rated capacities surpassed by the 10-year incoming flow are rendered in **red**, illustrating the pump stations that do not meet criteria in this scenario. The 10-year flows draining to the Bridgeport SPS, New Dundee SPS, and Shirley SPS in the 2031 future conditions scenario exceed their firm and rated capacities. The 10-year incoming flow to Bridgeport SPS, New Dundee SPS, and Spring Valley SPS also exceed their current ECA approved rates. Note that the Bridgeport SPS and Spring Valley SPS are owned by the Region of Waterloo and not the City of Kitchener.

Similarly to existing conditions, the pumping stations are rendered in **Figure 3-3** and **Figure 3-4** based on the whether the 10-year and 25-year flows, respectively, exceed the pumping station's ECA, firm or rated capacities in 2031 conditions. See figure legends for details.

Table 3-4: 2031 Future Conditions Pumping Station Performance

Pumping Station	10-Year Peak Flow (L/s)	25-Year Peak Flow (L/s)	ECA Capacity (L/s)	Firm Capacity (L/s)	Rated Capacity (L/s)	Notes
Apple Tree SPS	47.2	56.3	**50.0**	66.0	66.0	
Bancroft SPS	4.6	5.7	7.7	7.7	7.7	
Bridgeport SPS*	176.7	216.4	**136.0**	**136.0**	**136.0**	
Carson SPS	38.7	53.8	N/A	66.9	66.9	No ECA available
Chandos SPS	7.4	9.6	30.0	27.0	27.0	
Conestoga College SPS	4.5	5.2	50.0	47.5	47.5	
Falconridge SPS	16.0	18.5	118.0	45.5	45.5	
Homer Watson SPS	133.5	145.9	310.0	314.0	314.0	
King St SPS	150.6	185.4	290.0	176.0	176.0	
Manchester SPS	168.7	217.7	240.0	240.0	240.0	
Moore SPS	N/A	N/A	N/A	N/A	N/A	Decommissioned in 2031 scenario
New Dundee SPS	70.6	89.1	**56.0**	**56.0**	**56.0**	
Old Mill SPS	N/A	N/A	N/A	N/A	N/A	Decommissioned and replaced by New Old Mill SPS in 2031 scenario
Otterbein SPS	61.0	72.8	165.0	165.0	165.0	EA for proposed upgrades provided; notes 165 L/s design capacity
Oxford SPS	31.5	41.4	N/A	49.0	49.0	No ECA available
Patricia SPS	3.7	4.6	N/A	23.5	23.5	No ECA available
Pioneer Tower SPS	84.4	94.5	125.1	**70.0**	**70.0**	Pump station upgraded
River Birch SPS	9.3	12.5	17.3	19.0	19.0	
Shirley SPS	223.3	231.7	378.0	**207.0**	**207.0**	
Spring Valley SPS*	264.7	331.9	**245.0**	350.0	350.0	ECA to be updated with upgrades; current ECA allows for 245 L/s
Springmount SPS	113.0	136.8	205.5	162.0	162.0	
Stoke SPS	70.4	77.1	473.0	196.0	196.0	

Pumping Station	10-Year Peak Flow (L/s)	25-Year Peak Flow (L/s)	ECA Capacity (L/s)	Firm Capacity (L/s)	Rated Capacity (L/s)	Notes
Woolner SPS	90.3	109.1	115.2	136.0	136.0	
Nathalie SPS	15.5	17.9	148.0	98.0	98.0	
New Old Mill SPS	62.2	71.5	N/A	150.0	150.0	No ECA available
Notes: * Bridgeport SPS and Spring Valley SPS are owned by the Region of Waterloo						

3.1.4 2051 Horizon Growth and Infrastructure Updates

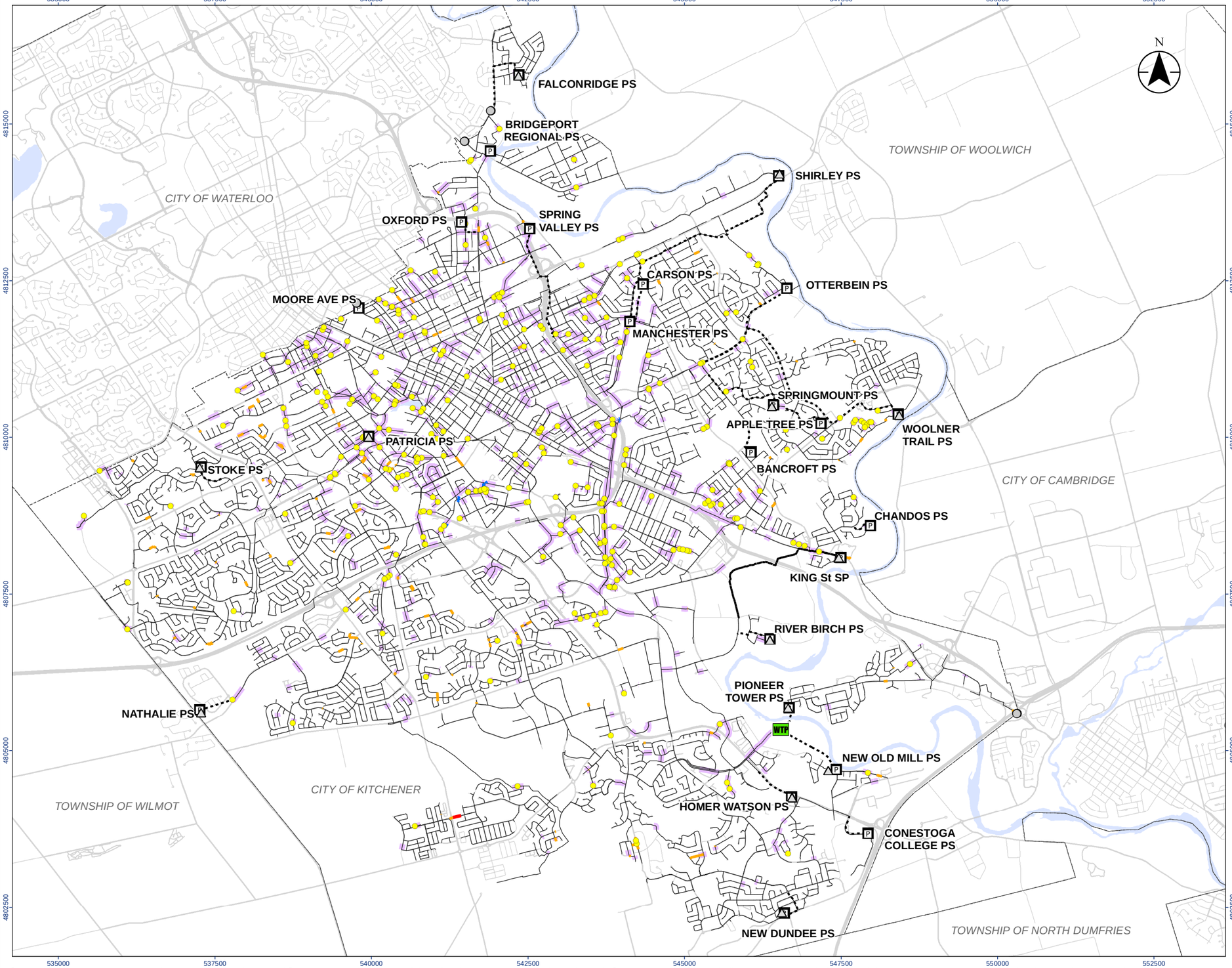
The 2051 flow generation, boundary conditions, and infrastructure updates were applied as outlined in **Section 8.2.4** of **TM2** and **Section 3.1.2** above.

This includes increasing the total serviced population to approximately 761K from 589K in 2031 future conditions based on the 75% build-out populations provided in the City's Parcel-People-Jobs (PPJ) file. Notably, this population forecast is greater than the actual population forecast for the City as a whole and is a result of over estimating individual growth areas in order to provide a level of conservatism in the growth forecasts. While growth forecasting for the City as a whole is considered relatively accurate, the location of that growth is more difficult to forecast and thus the data provided by the City accounts for some uncertainty as to the location of growth.

Additionally, the 2051 scenario incorporates a further proposed upgrade at the Spring Valley SPS, as per the provided EA study report. All other pumping station setups are maintained from the existing conditions scenario. **Table 3-5** outlines the pumping station updates made for the 2051 scenario. All other infrastructure and pumping station upgrades are maintained from the 2031 future conditions scenario (refer to **Section 3.1.2** for details).

Table 3-5: 2051 Updated Pumping Station Firm & Rated Capacities Based on Theoretical Operation

Pumping Station	Firm Capacity (L/s)	Rated Capacity (L/s)	Rated Capacity Pump Operation	ECA Firm Capacity (L/s)	Additional Notes
Spring Valley SPS	470.0	470.0	Unknown	245.0	Currently in EA process to upgrade SPS to an ultimate buildout capacity of 470 L/s ECA to be updated with upgrades; current ECA allows for 245 L/s



Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon
- Shallow Pipes (Obvert <= 1.8m of Surface)

HGL Freeboard

- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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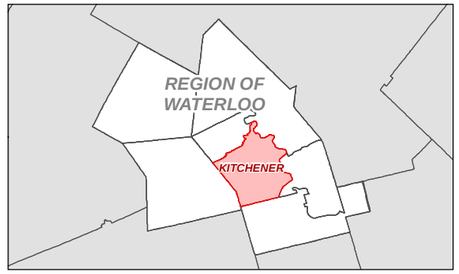

Project Location
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Figure No.
3.1

Title
2031 Future Conditions Sanitary Sewer System Dry Weather Flow HGL & Surcharge Results

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4815000 4812500 4810000 4807500 4805000 4802500

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FALCONRIDGE PS
BRIDGEPORT REGIONAL PS
SHIRLEY PS
OXFORD PS
SPRING VALLEY PS
CARSON PS
OTTERBEIN PS
MOORE AVE PS
MANCHESTER PS
SPRINGMOUNT PS
APPLE TREE PS
WOOLNER TRAIL PS
PATRICIA PS
STOKE PS
BANCROFT PS
CHANDOS PS
KING St SP
RIVER BIRCH PS
PIONEER TOWER PS
NATHALIE PS
NEW OLD MILL PS
HOMER WATSON PS
CONESTOGA COLLEGE PS
NEW DUNDEE PS

CITY OF WATERLOO
TOWNSHIP OF WOOLWICH
CITY OF CAMBRIDGE
CITY OF KITCHENER
TOWNSHIP OF WILMOT
TOWNSHIP OF NORTH DUMFRIES

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Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon
- Shallow Pipes (Obvert <= 1.8m of Surface)

HGL Freeboard

- Within Basement Level (Within 1.8m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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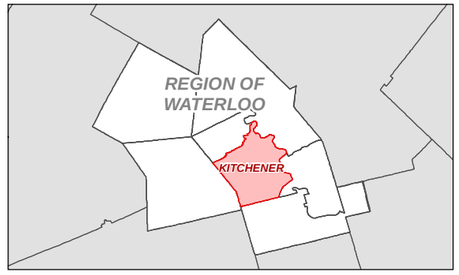

Project Location
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Figure No.
3.2

Title
2031 Future Conditions Sanitary Sewer System
5-Year HGL & Surcharge Results

535000 537500 540000 542500 545000 547500 550000 552500

4815000 4812500 4810000 4807500 4805000 4802500

N

FALCONRIDGE PS
BRIDGEPORT REGIONAL PS
SHIRLEY PS
OXFORD PS
SPRING VALLEY PS
CARSON PS
OTTERBEIN PS
MOORE AVE PS
MANCHESTER PS
SPRINGMOUNT PS
APPLE TREE PS
WOOLNER TRAIL PS
PATRICIA PS
STOKE PS
BANCROFT PS
CHANDOS PS
KING St SP
RIVER BIRCH PS
PIONEER TOWER PS
NATHALIE PS
WTP
NEW OLD MILL PS
HOMER WATSON PS
CONESTOGA COLLEGE PS
NEW DUNDEE PS

CITY OF WATERLOO
TOWNSHIP OF WOOLWICH
CITY OF CAMBRIDGE
CITY OF KITCHENER
TOWNSHIP OF WILMOT
TOWNSHIP OF NORTH DUMFRIES

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Legend

- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon
- Shallow Pipes (Obvert <= 1.8m of Surface)

Pumping Station 10yr Flow Results

- PS ECA Exceeded by 10yr Flow
- PS Firm & Rated Capacities Exceeded by 10yr Flow
- PS ECA, Firm & Rated Capacities Exceeded by 10yr Flow
- All Other PSs

HGL Freeboard

- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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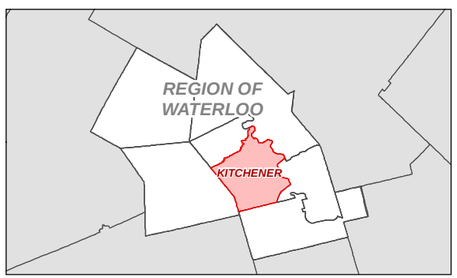

Project Location
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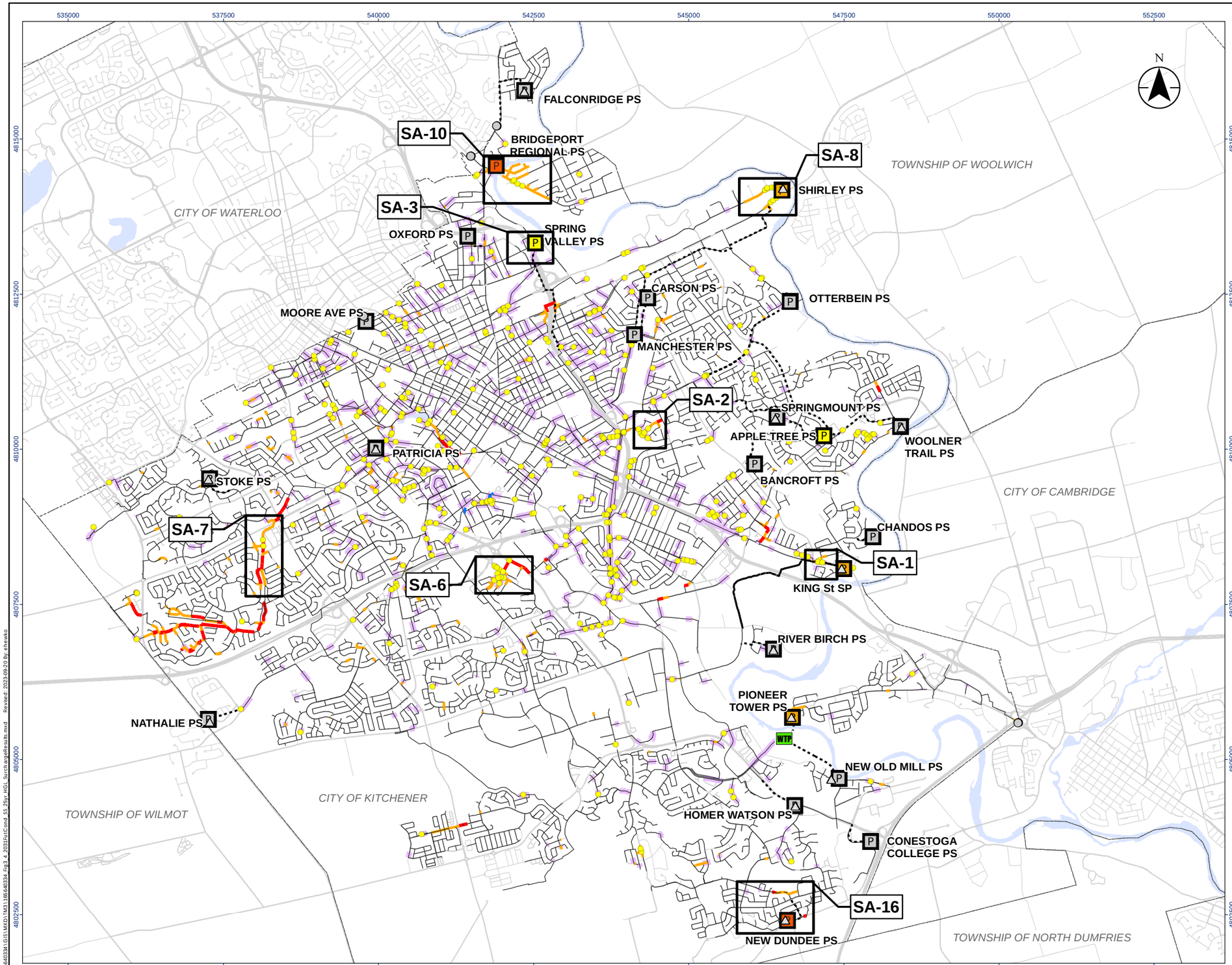
Figure No.
3.3

Title
2031 Future Conditions Sanitary Sewer System
10-Year HGL & Surcharge Results



Stantec

Legend

- Outflow to Adjacent System
- PS Overflow
- WWTP
- Siphon
- Shallow Pipes (Obvert <= 1.8m of Surface)

Pumping Station 25yr Flow Results

- PS ECA Exceeded by 25yr Flow
- PS Firm & Rated Capacities Exceeded by 25yr Flow
- PS ECA, Firm & Rated Capacities Exceeded by 25yr Flow
- All Other PSs

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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Notes

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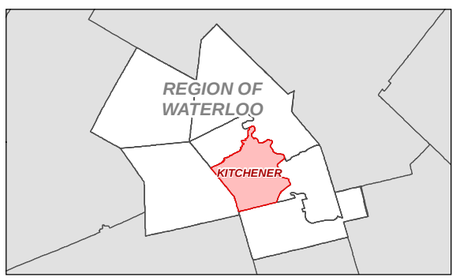

Project Location
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Figure No.
3.4

Title
2031 Future Conditions Sanitary Sewer System
25-Year HGL & Surcharge Results

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3.1.5 2051 Capacity-Based System Performance

The approach to the future conditions system assessment and criteria is consistent with that of the existing conditions system assessment, as described in **Section 2.1.5.1**. **Figure 3-5**, **Figure 3-6**, **Figure 3-7**, and **Figure 3-8** illustrate the modelled 2051 scenario HGL and surcharge results for the DWF, 5-year, 10-year, and 25-year events, respectively, and are presented with rendering as discussed in **Section 2.1.5.2**.

Based on the presented modelling results, no capacity constraints resulting in HGL issues are observed in the DWF conditions. Excluding siphons, forcemains or remaining inconsistent profiles, there are now seven (7) locations where the pipes were found to be 85% full or greater in DWF conditions. Five (5) of these locations are consistent with those observed in the 2031 scenario conditions (as described in **Section 3.1.3**), while the remaining two (2) are described below. All seven locations are not considered concerns with respect to capacity constraints in the system and do not result in HGL issues in the 25-year event.

- **One 300 mm diameter pipe (Asset ID 101338) that connects the Dreger Ave sewers to the Ottawa trunk via Graber Pl.** Pipe running 85% full or greater due to downstream trunk water level and connecting invert; and,
- **One 300 mm pipe (Asset ID 100033) along Fairway Rd S just upstream of the sewer that conveys flow through a private ICI property**. Due to a drop in pipe size from 375 mm to 300 mm and a flat slope of 0.03%.

The model comprises a total of 13,825 pipes, with 2,088 of these classified as trunk sewers. Under DWF conditions, around 79.2% (10,950 pipes) have maximum velocities less than 0.6 m/s. Focusing on the trunk sewers under DWF conditions, we find that about 36.1% experience maximum velocities less than 0.6 m/s.

Similar to DWF conditions, no capacity constraints resulting in HGL issues are observed in the 5-year storm event, other than the area upstream of the Shirley SPS, Dalewood Dr, King St, and Homer Watson Blvd, which are discussed further below. There are nine (11) locations that experience pipes 85% full or greater during this event due to sewer capacity constraints; five (5) of which see HGL issues in the 25-year event and are described below. The remaining seven (7) locations are not considered a concern as HGL issues are not generated by these capacity constraints in the 25-year design event.

- **Dalewood**, 250 mm sewers experience backwater during the 5-year event and surcharging and HGL issues in the 5- and 25-year events. This location is defined as an existing conditions problem area (SA-2);
- **Upstream of Shirley SPS**, HGL and surcharge issues are experienced in the 525 mm sewers in the 5- and 25-year events. This location is defined as an existing conditions problem area (SA-8);
- **Upstream of Bridgeport SPS**, 450 mm and 525 mm sewers experience backwater during the 5-year. HGL and surcharge issues are experienced in the 450 mm sewers in the 25-year events. This location is defined as an existing conditions problem area (SA-10);

- **King St**, HGL and surcharge issues are experienced in the 300 mm sewers in the 5- and 25-year events. This location is defined as an existing conditions problem area (SA-1)
- **Homer Watson Blvd**, 250 mm sewers experience backwater during the 5-year event and surcharging and HGL issues in the 5- and 25-year events. This location is defined as an existing conditions problem area (SA-6).

In the 25-year design event, one additional Problem Area (areas of observed sewer capacity constraints) is identified within the 2051 future conditions system. This area, in addition to those identified in existing conditions, are highlighted in **Figure 3-8** and described (**bolded**) in **Table 3-6**. Similarly to SA-16 identified in 2031 conditions, while this new problem area (SA-9) is identified in the figure, there are no HGL or surcharge issues shown. This is because this problem area arises only when the upstream Shirley SPS capacity is increased as part of solution development. **Figure 3-8** only shows the modelled results excluding solutions and thus, this is not evident. This area is however, accounted for in the problem area list, as it does require solutions. All other areas with HGL issues observed are representative of shallow sewers, or inconsistent profiles in local areas deemed to have minimal impact to the Master Plan.

Table 3-6: 2051 Future Conditions Sanitary Sewer Problem Areas

Problem Area ID	Applicable Scenario(s)	Location	Capacity Constraint Description
SA-1 Upstream of King St SPS	**Existing** **2031** **2051**	King St, east of River Rd E	HGLs within 1.8 m of surface due to undersized pipes. Low risk of basement flooding as no building connections are anticipated along these sewers.
SA-2 Dalewood	**Existing** **2031** **2051**	Dalewood Dr and Penrose Ave	Risk of basement flooding (HGLs within 1.8 m of surface) due to undersized pipes along Dalewood Dr.
SA-3 Upstream of Spring Valley SPS	**Existing** **2031** **2051**	Spring Valley SPS off of Riverbend Dr	HGLs within 1.8 m of surface due to downstream capacity constraints at the Spring Valley SPS. Low risk of basement flooding as no building connections are anticipated along these sewers.
SA-6 Homer Watson	**Existing** **2031** **2051**	Homer Watson Blvd	Risk of basement flooding along Kingswood Dr and Flint Dr due to undersized pipes within the private ICI property and on Homer Watson Blvd. HGLs within 1.8 m of surface on Alpine Rd and Homer Watson Blvd with low risk of basement flooding as no building connections are anticipated along these sewers.
SA-7 Sandrock Trunk	**Existing** **2031** **2051**	Highland Rd W and Fischer-Hallman Rd	HGLs within 1.8 m of surface due to undersized pipes along Highland Rd W. Low risk of basement flooding as no building connections are anticipated along these sewers.

Problem Area ID	Applicable Scenario(s)	Location	Capacity Constraint Description
SA-8 Upstream of Shirley SPS	**Existing** **2031** **2051**	Shirley Dr and Victoria St N	Risk of basement flooding and surface flooding along Shirley Dr due to downstream capacity constraints at the Shirley SPS. HGLs within 1.8 m of surface on Victoria St N with low risk of basement flooding as no building connections are anticipated along these sewers.
SA-10 Upstream of Bridgeport SPS	**Existing** **2031**	Bridge St E between Bloomingdale Rd and Grand Ave	Risk of basement flooding on Bridge St E due to downstream capacity constraints at the Bridgeport SPS. Risk of PS flooding.
SA-16 Downstream of New Dundee SPS	**2031** **2051**	Robert Ferrie Dr	Risk of basement flooding along Mossgrove Dr and Monarch Woods Dr due to undersized pipes on Robert Ferrie Dr.
SA-9 **Downstream of Manchester SPS**	**2051**	**Southeast of Manchester Dr/ River Rd E Intersection**	**HGLs within 1.8 m of surface due to undersized pipes downstream of the Manchester SPS. Low risk of basement flooding as no building connections are anticipated along these sewers.**

Additionally, the 10-year incoming peak flows are compared to the pumping station's firm, rated and ECA capacities to determine performance or approval issues. The following **Table 3-7** presents these results, along with the 25-year peak incoming flows for reference. The ECA, firm and rated capacities surpassed by the 10-year incoming flow are rendered in **red**, illustrating the pump stations that do not meet criteria in this scenario. The 10-year flows draining to the Bridgeport SPS, New Dundee SPS, and Shirley SPS in the 2051 future conditions scenario exceed their firm and rated capacities. The 10-year incoming flow to Apple Tree SPS, Bridgeport SPS, New Dundee SPS, and Spring Valley SPS also exceed their current ECA approved rates. Note that the Bridgeport SPS and Spring Valley SPS are owned by the Region of Waterloo and not the City of Kitchener.

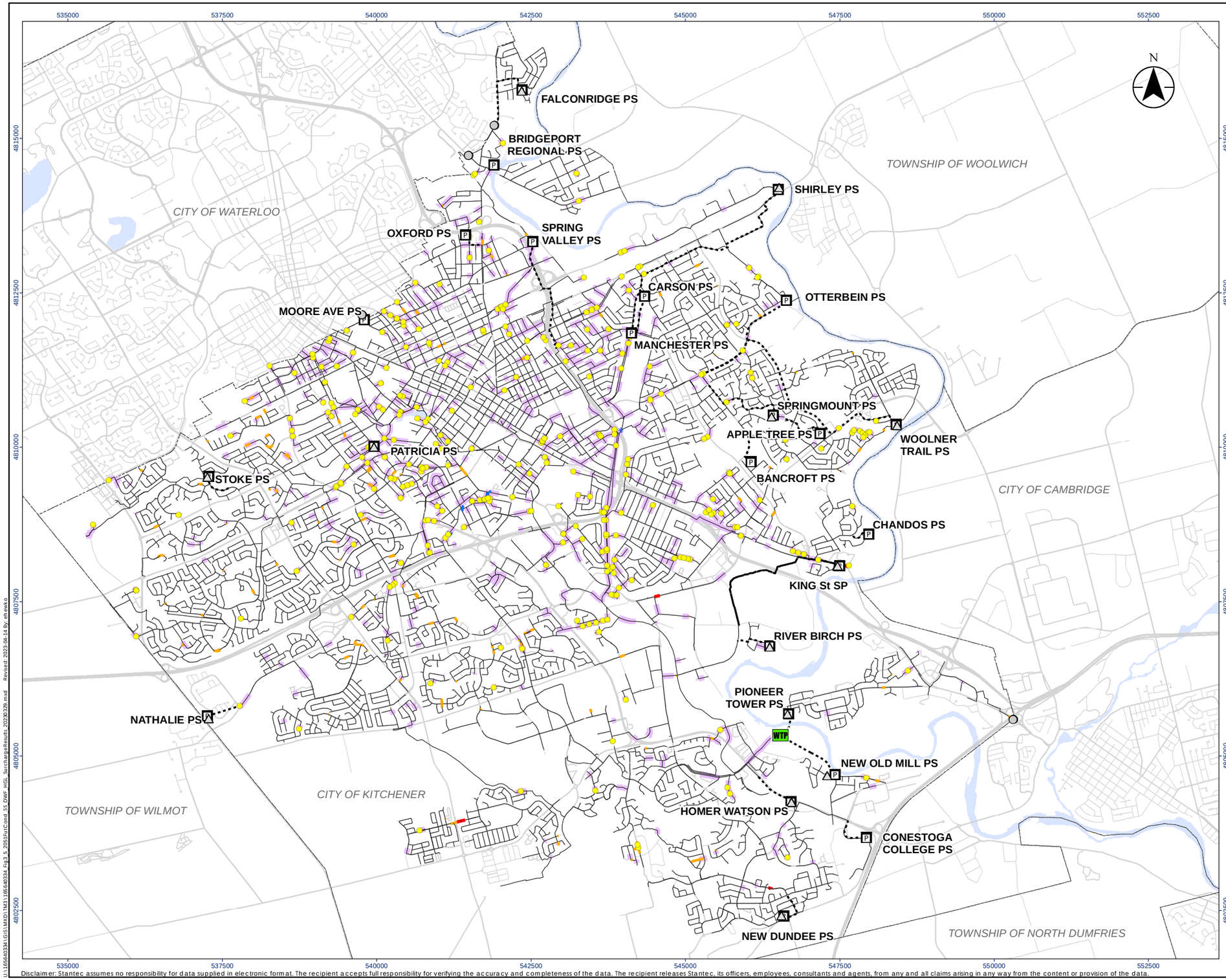
Table 3-7: 2051 Future Conditions Pumping Station Performance

Pumping Station	10-Year Peak Flow (L/s)	25-Year Peak Flow (L/s)	ECA Capacity (L/s)	Firm Capacity (L/s)	Rated Capacity (L/s)	Notes
Apple Tree SPS	51.8	60.9	**50.0**	66.0	66.0	
Bancroft SPS	4.6	5.7	7.7	7.7	7.7	
Bridgeport SPS*	179.0	224.4	**136.0**	**136.0**	**136.0**	
Carson SPS	39.7	59.1	N/A	66.9	66.9	No ECA available
Chandos SPS	7.7	9.9	30.0	27.0	27.0	
Conestoga College SPS	5.7	6.4	50.0	47.5	47.5	
Falconridge SPS	16.4	18.9	118.0	45.5	45.5	
Homer Watson SPS	139.1	151.4	310.0	314.0	314.0	

Pumping Station	10-Year Peak Flow (L/s)	25-Year Peak Flow (L/s)	ECA Capacity (L/s)	Firm Capacity (L/s)	Rated Capacity (L/s)	Notes
King St SPS	161.8	195.2	290.0	176.0	176.0	
Manchester SPS	176.9	225.9	240.0	240.0	240.0	
Moore SPS	N/A	N/A	N/A	N/A	N/A	To be decommissioned
New Dundee SPS	75.4	93.9	**56.0**	**56.0**	**56.0**	
Old Mill SPS	N/A	N/A	N/A	N/A	N/A	Previously decommissioned
Otterbein SPS	69.0	80.7	165.0	165.0	165.0	EA for proposed upgrades provided; notes 165 L/s design capacity
Oxford SPS	32.0	41.9	N/A	49.0	49.0	No ECA available
Patricia SPS	3.7	4.6	N/A	23.5	23.5	No ECA available
Pioneer Tower SPS	86.7	95.8	125.1	**70.0**	**70.0**	Pump station upgraded
River Birch SPS	9.3	12.5	17.3	19.0	19.0	
Shirley SPS	225.1	232.6	378.0	**207.0**	**207.0**	
Spring Valley SPS*	279.2	345.3	**245.0**	470.0	470.0	ECA to be updated with upgrades; current ECA allows for 245 L/s
Springmount SPS	121.4	145.1	205.5	162.0	162.0	
Stoke SPS	75.4	82.0	473.0	196.0	196.0	
Woolner SPS	91.7	110.6	115.2	136.0	136.0	
Nathalie SPS	17.9	20.2	148.0	98.0	98.0	
New Old Mill SPS	62.8	72.1	N/A	150.0	150.0	No ECA available

Notes:
* Bridgeport SPS and Spring Valley SPS are owned by the Region of Waterloo

Similarly to existing and 2031 conditions, the pumping stations are rendered in **Figure 3-7** and **Figure 3-8** based on the whether the 10-year and 25-year flows, respectively, exceed the pumping station's ECA, firm or rated capacities in 2051 conditions. See figure legends for details.



Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon
- Shallow Pipes (Obvert <= 1.8m of Surface)

HGL Freeboard

- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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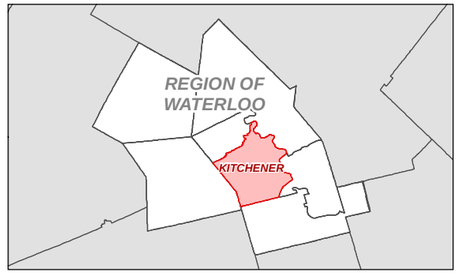

Project Location
City of Kitchener

165640334 REVA
Prepared by EH on 2023-04-14

Client/Project
CITY OF KITCHENER
INTEGRATED SANITARY MASTER PLAN

Figure No.
3.5

Title
2051 Future Conditions Sanitary Sewer System Dry Weather Flow HGL & Surcharge Results

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535000 537500 540000 542500 545000 547500 550000 552500

4815000 4812500 4810000 4807500 4805000 4802500

N

FALCONRIDGE PS
BRIDGEPORT REGIONAL PS
SHIRLEY PS
OXFORD PS
SPRING VALLEY PS
CARSON PS
OTTERBEIN PS
MOORE AVE PS
MANCHESTER PS
SPRINGMOUNT PS
APPLE TREE PS
WOOLNER TRAIL PS
PATRICIA PS
STOKE PS
BANCROFT PS
CHANDOS PS
KING St SP
RIVER BIRCH PS
PIONEER TOWER PS
NATHALIE PS
NEW OLD MILL PS
HOMER WATSON PS
CONESTOGA COLLEGE PS
NEW DUNDEE PS

TOWNSHIP OF WOOLWICH
CITY OF WATERLOO
CITY OF CAMBRIDGE
CITY OF KITCHENER
TOWNSHIP OF WILMOT
TOWNSHIP OF NORTH DUMFRIES

535000 537500 540000 542500 545000 547500 550000 552500

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Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon
- Shallow Pipes (Obvert <= 1.8m of Surface)

HGL Freeboard

- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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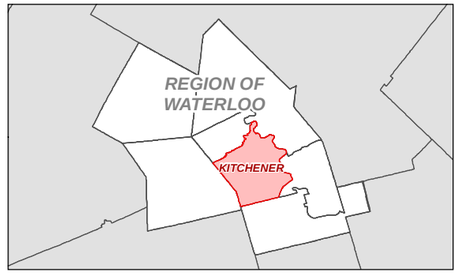


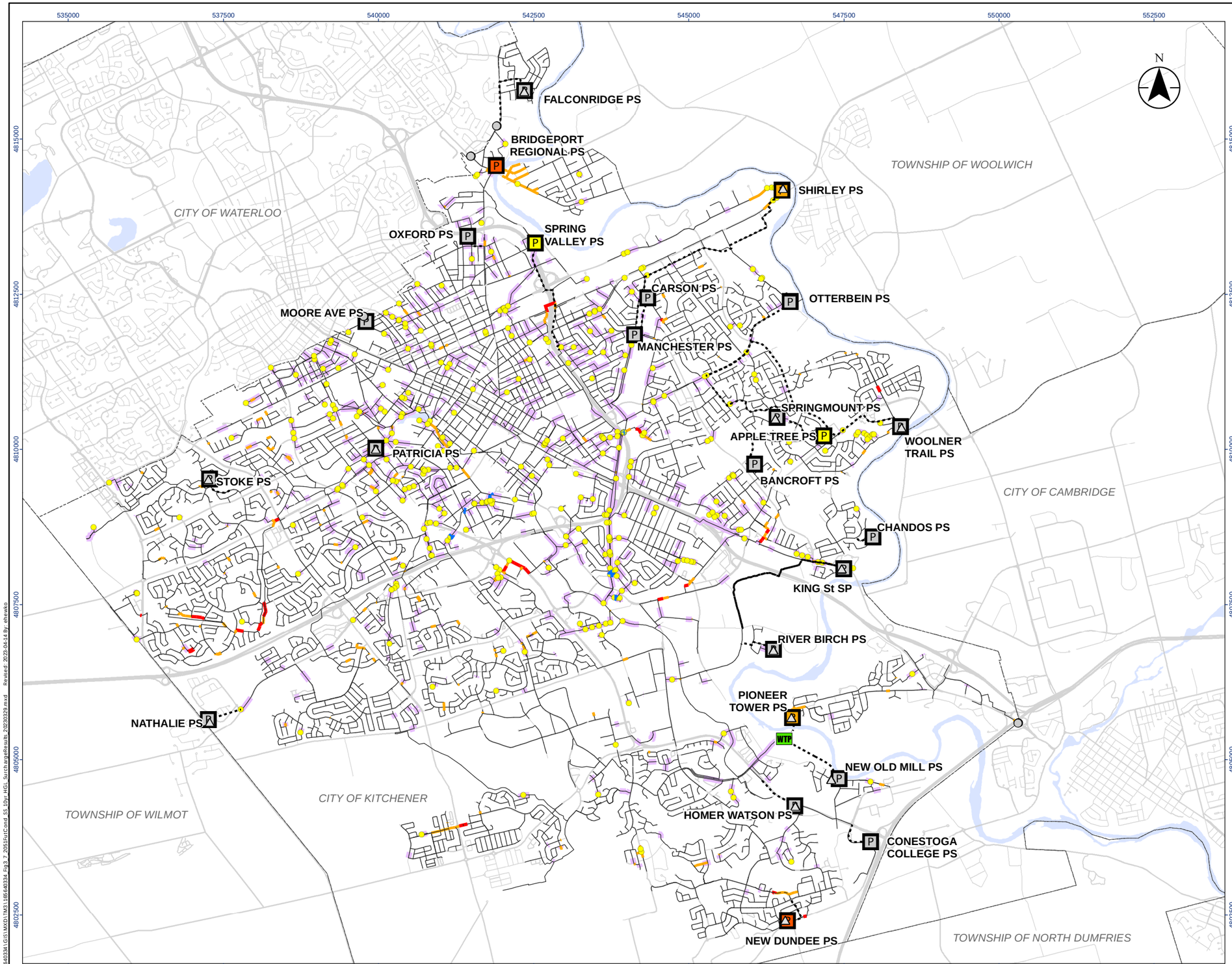
Project Location
City of Kitchener

165640334 REVA
Prepared by EH on 2023-09-20

Client/Project
CITY OF KITCHENER
INTEGRATED SANITARY MASTER PLAN

Figure No.
3.6

Title
2051 Future Conditions Sanitary Sewer System
5-Year HGL & Surcharge Results



Stantec

Legend

- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon
- Shallow Pipes (Obvert <= 1.8m of Surface)

Pumping Station 10yr Flow Results

- PS ECA Exceeded by 10yr Flow
- PS Firm & Rated Capacities Exceeded by 10yr Flow
- PS ECA, Firm & Rated Capacities Exceeded by 10yr Flow
- All Other PSs

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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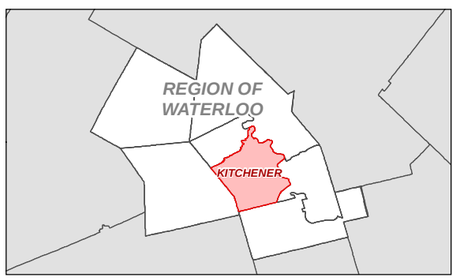

Project Location
City of Kitchener

165640334 REVA
Prepared by EH on 2023-04-14

Client/Project
CITY OF KITCHENER
INTEGRATED SANITARY MASTER PLAN

Figure No.
3.7

Title
2051 Future Conditions Sanitary Sewer System
10-Year HGL & Surcharge Results

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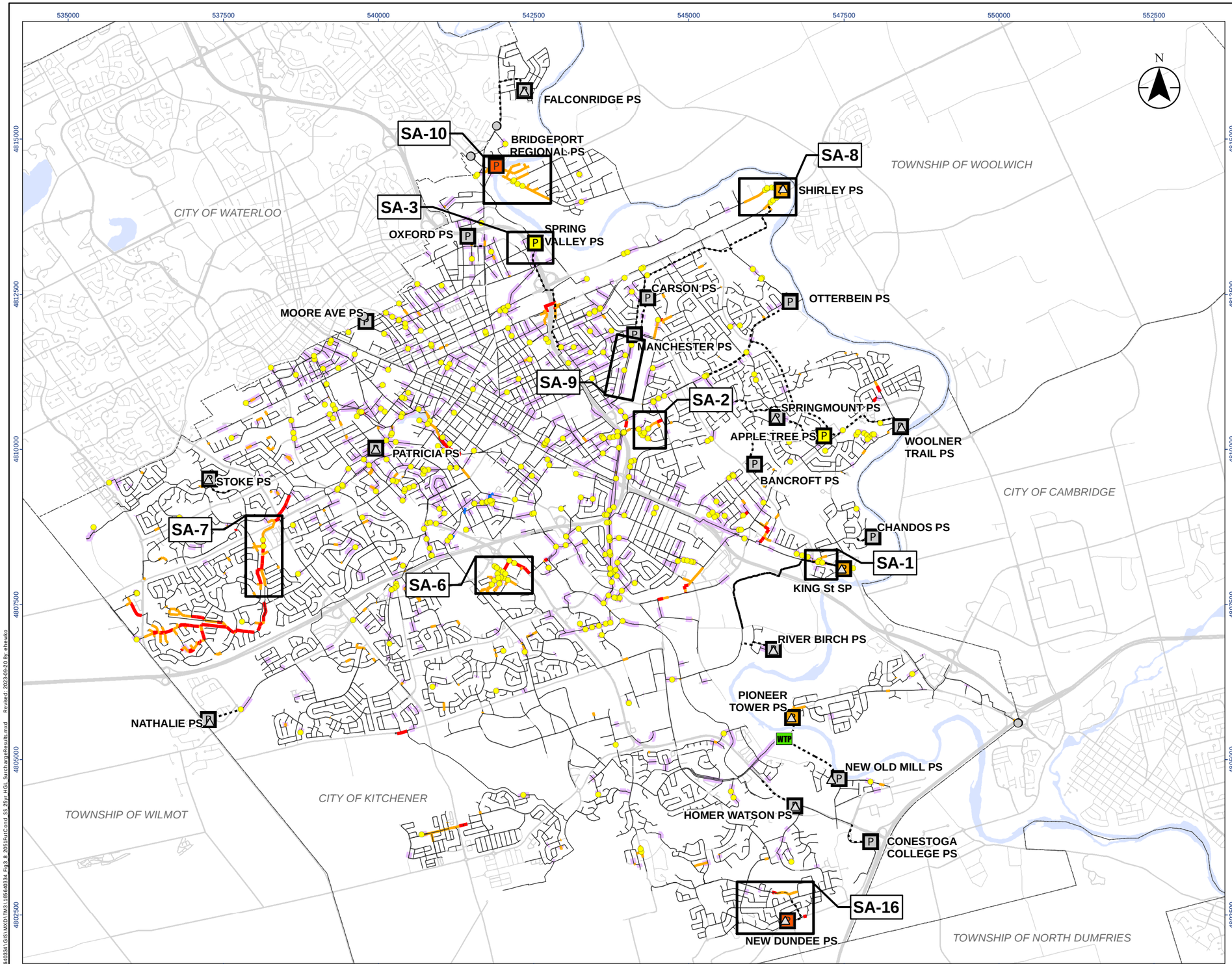

Stantec

Legend

- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon
- Shallow Pipes (Obvert <= 1.8m of Surface)

Sanitary Pumping Stations

- PS ECA Exceeded by 25yr Flow
- PS Firm & Rated Capacities Exceeded by 25yr Flow
- PS ECA, Firm & Rated Capacities Exceeded by 25yr Flow
- All Other PSs

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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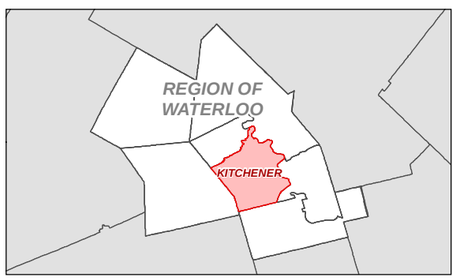

Project Location
City of Kitchener

165640334 REVA
Prepared by EH on 2023-09-20

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Figure No.
3.8

Title
2051 Future Conditions Sanitary Sewer System
25-Year HGL & Surcharge Results

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3.2 CLIMATE CHANGE

Climate change IDF curves from the available IDF Climate Change (CC) Tool are used to establish factors that increase the 25-year AES, 12-hour design storm rainfall intensities to account for climate change (herein identified as the 25-year + CC event), which is then used to test the system for sensitivity. These factors are based on historical trends and widely accepted climate models included within the IDF CC Tool. The Waterloo Wellington A rain gauge data is used in conjunction with IDF CC Tool's CMIP6 All Models option under SSP5.85 conditions, which represents a prediction of 8.5 W/m^2 of radioactive forcing by 2100 (the most conservative concentration scenario available; Simonovic, S.P., A. Schardong, R. Srivastav, and D. Sandink (2015), *IDF_CC Web-based Tool for Updating Intensity-Duration-Frequency Curves to Changing Climate – ver 6.5*, Western University Facility for Intelligent Decision Support and Institute for Catastrophic Loss Reduction, open access https://www.idf-cc-uwo.ca). While the Kitchener City Eng 2 RG is closer in proximity to the city than the Waterloo Wellington A RG, the Waterloo RG offers a larger and thus more reliable historical dataset (33 years' worth) to base the prediction on than the Kitchener City RG (13 years' worth of data) and was therefore selected for this analysis. The resulting predicted rainfall data, however, represents a 67% increase in total rainfall volume and intensity from the current Kitchener City Eng 2 for the same return period and duration, which is considered excessively conservative. Running this event resulted in significant worsening and extension of already identified capacity constraints. Typically, climate change predictions results in rainfall increases closer to 20% from current design storms for the same RG. Therefore, the 25-year AES, 12-hour design storm rainfall timeseries was simply increased by 20% and used as the 25-year + CC event. These climate change model results are used to test the sensitivity of the proposed solutions and is therefore presented in **Section 4.3.2** below.

3.3 FUTURE CONDITION-BASED SYSTEM ASSESSMENTS

With ongoing CCTV and condition-based data collection programs, the City can continue to identify required asset renewals based on CCTV scores of 4 or higher and the other criteria outlined in **Section 2.2.1**.

3.4 FUTURE SANITARY SEWER SYSTEM DATA COLLECTION AND MANAGEMENT PROGRAMS

It is our understanding that the City intends to continue collecting sewer condition data, rainfall and flow monitoring data, and conducting sewer and hot spot flushing, I/I estimations and hydraulic model updates. **Section 4.0** discusses recommended modifications to the current programs or frequencies to improve the results of the City's efforts, as part of this Integrated Sanitary Master Plan.

Additionally, the Region of Waterloo has engaged KEB Engineering & Project Management to review opportunities in implementing a heat recovery program, where the thermal energy generated from wastewater temperatures in trunk sewers is harnessed and used to power nearby facilities and buildings.

Opportunities are identified based on the magnitude of flows observed, which translates into the amount of potential heat recovery. The City of Kitchener has expressed interest in implementing a temperature monitoring system while performing standard system maintenance and other data collection programs. Once trends are established, this information can be considered when upgrading or designing new sanitary sewer subsystems to increase heat recovery potential. Data collection provides a good start in the implementation of a heat recovery program, but must be paired with community, city planning, and developer engagement for successful implementation, as these facilities must be properly fitted to harness the benefits of this program. Thus, the implementation of a heat recovery program is not included in the alternative solutions as the data collection programs required to initiate this process are inherently included in this ISAN-MP, following which, stakeholder engagement would be required.

4.0 ALTERNATIVE SOLUTIONS

The alternative solutions are assessed following Approach 2 of the Municipal Class Environmental Assessment (MCEA, or EA) process, which includes the completion of both Phases 1 and 2, where the requirements for Schedule B projects are fulfilled within the scope of this ISAN-MP. The alternative solutions are not only intended to resolve capacity-based and condition-based concerns within the sanitary trunk sewer system, but also provide the City with recommendations to improve their data collection and mitigation programs, delivering a holistic approach to the Master Plan.

The solutions assessed are broken down into four (4) separate alternatives, which can be combined to provide an overall solution plan for the City. These four alternatives include the following and are described in detail in **Sections 4.1** to **4.4** below.

- Alternative 1 – Do Nothing
- Alternative 2 – Shaping Community Growth
- Alternative 3 – Infrastructure Updates
- Alternative 4 – Data Acquisition, Flow Monitoring, and I/I Mitigation Programs

4.1 ALTERNATIVE 1 – DO NOTHING

The Do Nothing alternative for capacity-based and condition-based concerns, as well as data collection and mitigation programs does not align with the City's strategy for the Integrated Sanitary MP and thus has been screened out from the EA process.

4.2 ALTERNATIVE 2 – SHAPING COMMUNITY GROWTH

Community growth results in an increase in sanitary flows in the downstream system and can therefore lead to the creation or worsening of sanitary sewer capacity constraints. Community growth can thus be shaped to limit negative impacts to the downstream system by encouraging growth in available areas that drain to portions of the system that can handle the additional flows without restriction. Sewer upgrades can however be implemented if needed to allow for the upstream growth to occur, if the required upgrades are reasonable in cost, benefit, and extent. This review is most valuable on a trunk level, as local pipe restrictions can be resolved relatively easily. Based on existing conditions, 2031 and 2051 system assessment results, there are no significant concerns with trunk sewer capacity within the sanitary system, other than the Sandrock trunk and some of the larger pumping stations (Shirley SPS and New Dundee SPS) which can be resolved with relatively minor upgrade requirements. Proposed infrastructure solutions is further discussed in **Section 4.3**.

Growth reviews should occur regularly to confirm that no major restrictions arise in the future. The best approach to accomplish this is to continue to regularly engage in Master Planning updates where infrastructure upgrades are incorporated along with potential growth predictions.

4.3 ALTERNATIVE 3 – INFRASTRUCTURE UPDATES

Infrastructure update alternatives consist of both capacity and condition-based upgrades and are recommended to resolve system capacity restrictions and degrading sewer conditions. These solutions are discussed in the following sections.

4.3.1 Capacity-Based Solutions

Solutions to the identified capacity constraints outlined in **Section 2.1.5.2**, **3.1.3** and **3.1.5** are sized based on the following criteria, where feasible, as per the City of Kitchener Development Manual (Summer 2021), the Region of Waterloo and Area Municipalities Design Guidelines for Supplemental Specifications for Municipal Sewers (DGSSMS; January 2021) and were discussed with the City:

- Depth of flow to diameter (d/D) ratio is no higher than 80% in DWF conditions (lower d/D ratios may be considered in trunks to facilitate maintenance activities);
- Full flow velocity is appropriate to provide scour and peak flow velocity is less than the maximum allowable (0.8 m/s > v > 3 m/s);
- No HGL issues observed due to capacity constraints in the 25-year AES design event; and,
- Pumping stations have adequate firm capacity to convey the 10-year AES peak flows, and do not experience overflows in events smaller than the 25-year AES storm event.

The proposed solutions are designed based on the criteria outlined below, as per the Development Manual and DGSSMS, as referenced above.

Parameter	Design Value
Minimum Sewer Size (mm)	200
Minimum Sewer Slope (%)	Based on MECP Guidelines to achieve minimum flow velocity of 0.8 m/s
Minimum Drop Across Maintenance Holes (cm)	3 - 6
Minimum Cover (m)	2.8
Minimum Vertical Clearance at Sewer Crossings (m)	0.5

The proposed solutions are presented in **Table 4-1** below, along with the estimated Opinion of Probable Cost (OPC) per solution. Solutions include both linear infrastructure upgrades and pumping station upgrades and are listed by their Project ID (CB-#, where CB refers to Capacity-Based solutions).

The solutions are ordered based on a high-level assessment of priority, which predominately focuses on prioritizing solutions that are required in the near-term to resolve issues experienced in existing conditions, medium-term to resolve issues that are triggered under 2031 conditions, and long-term to resolve issues that are triggered in 2051. Within each horizon however, the prioritization is assumed equal.

The OPCs are considered Class D estimates (+/- 25-30%) and are provided based on 2022 dollars. These costs and have been rounded to the nearest thousand. These OPCs can be used to help inform the City's budgeting process that occurs every 4 years. Thus, all near-term projects should be included within this year's budget, while all 2031 and 2051 solutions should be accounted for in future budgets, if still found to be required based on forthcoming Master Plan updates.

In most cases, the required solutions are simple in nature, in that only a few pipe segment upgrades within City-owned Right-of-Way (ROW) or easement property are required to reduce HGLs below 1.8 m from surface. Pumping station capacity constraints are typically resolved by replacing an existing pump or adding pump(s) where provisional allowances already exist. Thus, alternative solutions are not explored for most areas as limited variations of these solutions exist and would only be less cost effective. There are however, two (2) locations where alternative infrastructure upgrade solutions are explored due to property ownership restrictions. These include Dalewood (CB-2) and Homer Watson (CB-3). Their alternatives are presented in the following table.

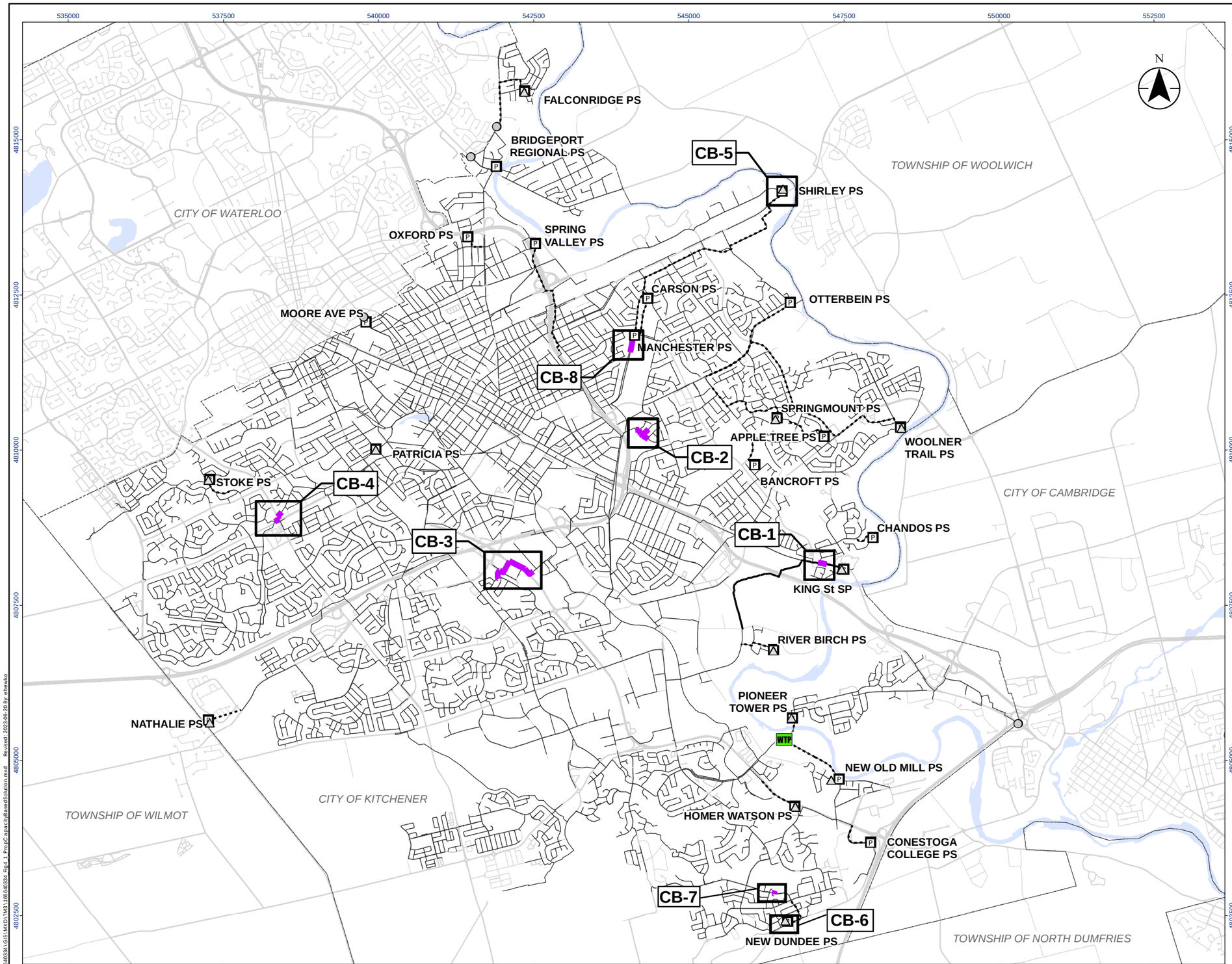
Three (3) sewer and pumping station capacity-based problem areas are not addressed with proposed solutions as their capacity concerns are generated by restrictions at either the Spring Valley SPS or the Bridgeport SPS. Both pumping stations are owned and operated by the Region of Waterloo and not the City of Kitchener and are thus not included in the following project list. A solution for problem area SA-10 defined in **Section 2.1.5.2** is also not proposed, as it is a result of the capacity constraints at the Bridgeport SPS.

The following **Figure 4-1** illustrates the locations of these proposed solution pipes and pump station upgrades. The 2051 future conditions 25-year HGL and surcharge results with solutions implemented are illustrated in **Figure 4-2**. Refer to **Appendix B** for further solution details, including close-up plan views and profiles of each of the proposed solutions.

Table 4-1: Existing and Future Conditions Capacity-Based Sewer Solutions

Project ID	Relevant Problem Area ID	Scenario Triggered	Solution Description	Estimated Opinion of Probable Cost	Contingency Allowance (30%)	Engineering Allowance (20%)	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
CB-1: Upstream of King St SPS	**SA-1**	**Existing** (Near-Term Priority)	Replacement of 2 lengths of sewer - upsize from 300 mm diameter to 375 mm diameter sewer	$499,000	$149,700	$129,740	$32,435	$810,875	$811,000
CB-2: Dalewood	**SA-2**	**Existing** (Near-Term Priority)	Alternative A - Replacement of 3 lengths of sewer on Dalewood one upgrade to 300 mm and two upgrade to 375 mm, and 2 lengths of sewer on Penrose upgraded to 300 mm diameter	$765,920	$229,776	$199,139	$49,784	$1,244,620	$1,245,000
			Alternative B - Replacement of 3 lengths of sewer on Dalewood, 2 lengths of sewer on Penrose and one length of sewer through the easement - all pipes upgraded to 300 mm diameter	$900,000	$270,000	$234,000	$58,500	$1,462,500	$1,463,000
CB-3: Homer Watson	**SA-6**	**Existing** (Near-Term Priority)	Alternative A – Replacement of 7 lengths of sewer on Homer Watson due to capacity, replacement of 2 lengths of sewer on comm. property due to capacity/condition, replacement of 7 lengths of sewer on Alpine due to capacity/condition, replacement of 2 lengths of sewer on Flint due to capacity, replacement of 1 length of sewer on Kingswood due to condition.	$2,445,443	$733,633	$635,815	$158,954	$3,973,845	$3,974,000
			Alternative B - Replacement of 5 lengths of sewer upstream of commercial property with 675 mm diameter sewer and replacement of 7 lengths of sewer downstream of	$2,306,418	$691,925	$599,669	$149,917	$3,747,929	$3,748,000

Project ID	Relevant Problem Area ID	Scenario Triggered	Solution Description	Estimated Opinion of Probable Cost	Contingency Allowance (30%)	Engineering Allowance (20%)	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
			commercial property with 300 mm diameter sewer						
CB-4: Sandrock Trunk	**SA-7**	**Existing** (Near-Term Priority)	Replacement of 3 lengths of sewer - upsizing from 675 mm diameter to 750 mm diameter sewer	$1,448,000	$434,400	$376,480	$94,120	$2,353,000	$2,353,000
CB-5: Shirley SPS	**SA-8**	**Existing** (Near-Term Priority)	Increase PS capacity to 378 L/s firm capacity - project involves addition of pumps to accommodate higher flows ECA update not required	$285,760	$85,728	$74,298	$18,574	$464,360	$- *(Upgrade to be paid for by Township of Woolwich)*
CB-6: New Dundee SPS	**New Dundee SPS - Capacity Constraint (Table 2-4)**	**2031** (Medium-Term Priority)	Increase PS capacity to 75 L/s firm capacity – project involves addition of pumps to accommodate higher flows ECA update required	$477,336	$143,201	$124,107	$31,027	$775,671	$776,000
CB-7: Robert Ferrie	**Downstream of New Dundee SPS**	**2031** (Medium-Term Priority)	Replacement of 1 length of sewer downstream of New Dundee FM discharge to 375mm diameter	$495,550	$148,665	$128,843	$32,211	$805,269	$805,000
CB-8: Manchester	**SA-9**	**2051** (Long-Term Priority)	Replacement of 2 lengths of sewer to 825mm diameter downstream of Shirley and Manchester SPS discharge	$693,015	$207,905	$180,184	$45,046	$1,126,149	$1,126,000
Totals				**$10,316,442**	**$3,094,933**	**$2,682,275**	**$670,568**	**$16,764,218**	**$16,301,000**



Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Other Sewers
- Forcemain
- Capacity-Based Solution

0 1 2 km

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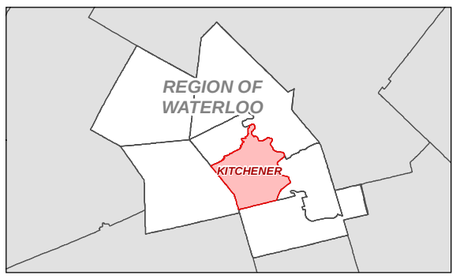

Project Location
City of Kitchener

165640334 REVA
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Figure No.
4.1

Title
Proposed Capacity-Based Solutions

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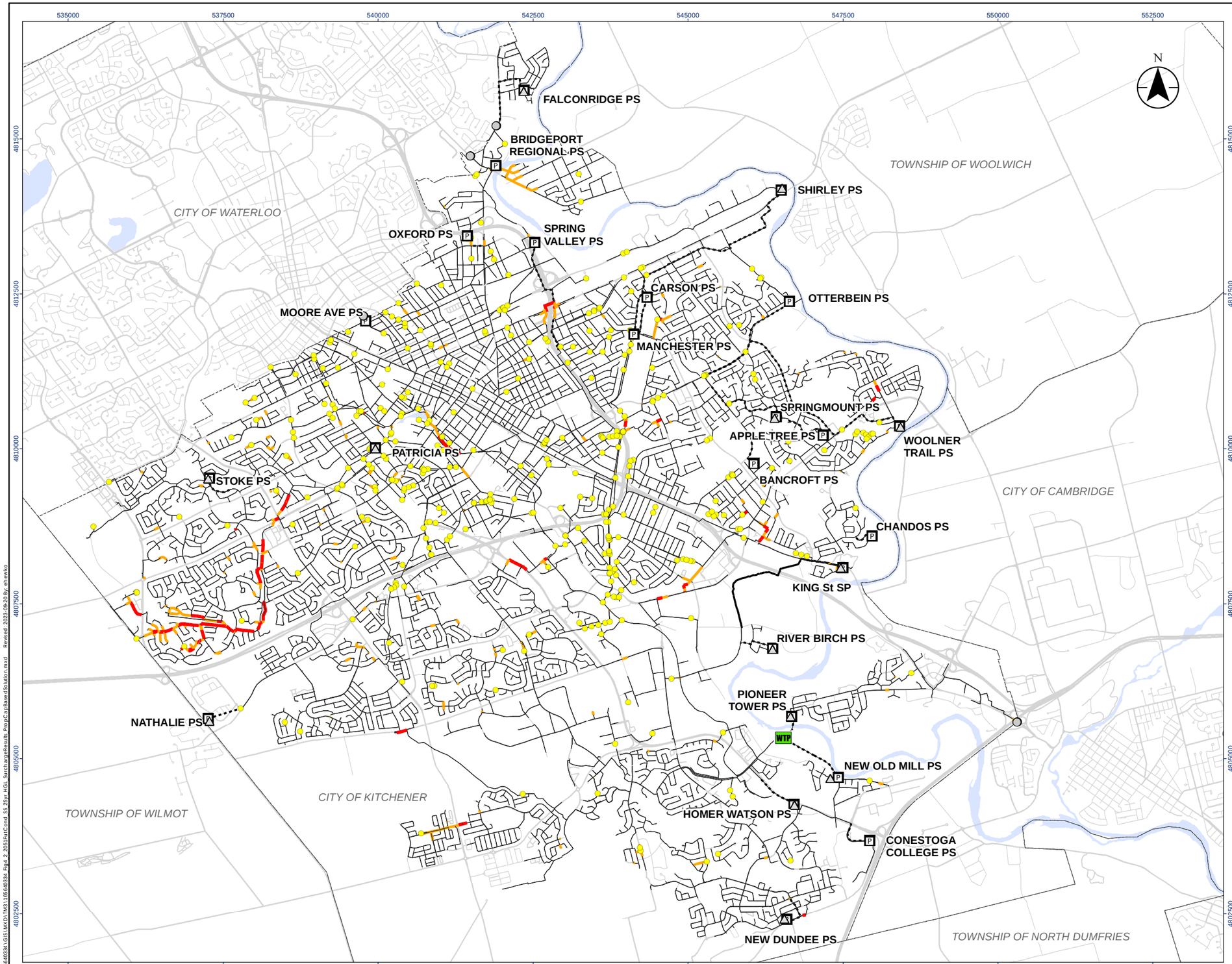

Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Other Sewers
- Forcemain

HGL Freeboard

- Within Basement Level (Within 1.8 m or Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

1:62,500 (At original document size of 11x17)

Notes

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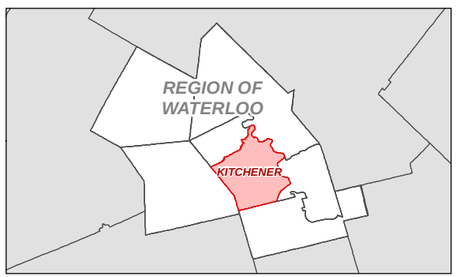

Project Location
City of Kitchener

165640334 REVA
Prepared by EH on 2023-09-20

Client/Project
CITY OF KITCHENER
INTEGRATED SANITARY MASTER PLAN

Figure No.
4.2

Title
2051 Future Conditions Sanitary Sewer System 25-Year HGL & Surcharge Results with Proposed Capacity-Based Solutions

4.3.1.1 Alternatives Review

As mentioned in **Section 4.3.1**, alternative solutions are not explored for most problem areas as limited variations of these simpler solutions exist. There are however, two (2) locations where alternative infrastructure upgrade solutions are explored due to property ownership restrictions. These include Dalewood (CB-2) and Homer Watson (CB-3). Their alternatives are detailed and evaluated in the following **Table 4-2**.

Table 4-2: Alternatives Evaluation

Evaluation Element	Alternative A	Alternative B
Dalewood		
Project ID	CB-2	
Location	Dalewood Dr, Penrose Ave	
Description	Capacity upgrades (1 x 300 mm pipes, and 2 x 375 mm) on Dalewood Dr and (2 x 300 mm) on Penrose Ave. Avoids upgrade through pathway between Dalewood Dr and GRCA lands.	Capacity upgrade (6 x 300 mm pipe) on Dalewood Dr, on Penrose Ave, and through pathway between Dalewood Dr and GRCA lands. Majority of segment is within City-owned easement with 3.5 m of sewer in GRCA lands.
Opinion of Probable Cost[1]	$1,245,000	$1,463,000
Pros	• Avoids easement/private property upgrades resulting in fewer permitting requirements • Reduces HGL concerns in Dalewood area	• Eliminates HGL concerns throughout the area • Easement pipe upgrade can be done simultaneously to scheduled adjacent storm pipe upgrade • Meets cover, drop across MHs and velocity requirements
Cons	• Does not eliminate HGL concern at corner of Dalewood and pathway easement due to shallow downstream pipe • Does not meet cover, drops across MHs or velocity requirements due to shallow downstream pipe	• Requires pipe construction through easement.
Recommendation	Alternative B – Due to the scheduled adjacent storm pipe upgrade through this easement, the ability to meet the design criteria, and the resulting hydraulic performance in the sanitary system, Alternative B is recommended, as per the City's preference.	

Evaluation Element	Alternative A	Alternative B
Homer Watson		
Project ID	CB-3	
Location	Homer Watson Blvd, Flint Dr, Alpine Rd, Hanson Ave	
Description	Replacement of 7 lengths of sewer on Homer Watson due to capacity, replacement of 2 lengths of sewer on commercial property due to capacity/condition, replacement of 7 lengths of sewer on Alpine due to capacity/condition, replacement of 2 lengths of sewer on Flint due to capacity, replacement of 1 length of sewer on Kingswood due to condition.	Inline storage (3 x 675 mm pipes) on Flint Dr and Alpine Rd to avoid pipe upgrades through private commercial property. Capacity upgrades (7 x 300 mm pipes) on Homer Watson Blvd and Hanson Ave downstream of private property
Opinion of Probable Cost[1]	$3,974,000	$3,748,000
Pros	• Smaller pipe sizes required • Achieves requirements for cover, drops across MHs and velocity, except at upstream-most and downstream-most solution pipes	• Avoids upgrades in private property • Achieves requirements for drops across MHs and velocity
Cons	• Requires upgrades in private property	• Does not achieve cover requirements due to inverts of private property pipes, however, cover is > 1.8 m, which at least does not result in 'shallow' sewers, as defined in **Section 2.1.5.2,** where HGLs are always within typical basement depths
Recommendation	Alternative A – Due to condition of the sewers in commercial private property, Alternative A is preferred, which also achieves the minimum cover requirement as per the Design Guidelines (2.8 m).	
1. As per Opinion of Probable Cost discussed in **Section 4.3.1**.		

As the table above indicates, Alternative B is recommended for Dalewood problem area and Alternative A is recommended for Homer Watson problem area. The total recommended budgetary estimate for all proposed solutions, including only the recommended alternatives for CB-2 and CB-3, is $16,301,000, as per **Table 4-1** of **Section 4.3.1**.

Another mitigation measure that should be considered involves reviewing building permits in the problem areas. This would generally apply to areas that are industrial or commercial in nature as these structures generally do not have basements. Review of these areas would identify if there are any existing basements and, if the area lacks any basements, the City may consider prohibiting the construction of basements on new structures. This may eliminate the need for upgrades which are triggered by surcharging at less than 1.8 meters from the surface.

4.3.2 Capacity-Based Solutions Sensitivity

As discussed in **Section 3.2**, a 20% increase to the 25-year 30% AES design storm event rainfall is used to generate the climate change/stress-test event (herein referred to as CC). This event was then used to test the sensitivity of proposed capacity-based solutions as defined in **Section 4.3.1** under the 2051 growth scenario. As anticipated, the higher intensity/volume rainfall results in the expansion of some (5) existing problem areas and the development of several (7) new problem areas. The sensitivity of the proposed solutions for each problem area is documented in the following **Table 4-3** which also includes the list of new problem areas and the estimated magnitude of solution required to solve the HGL concerns observed in the climate change event. Sensitivities are presented in red font and categorized by Minor Sensitivity and **Significant Sensitivity**, where minor sensitivities would require minor, simple upgrades to resolve, while significant sensitivities would require major, more complex upgrades. The climate change results are illustrated in **Figure 4-3**.

Table 4-3: Climate Change Impacts to Proposed Solutions

Problem Area	Existing vs. New Problem Area	Solutions Sensitivity in Climate Change Event	Trunk vs. Local	Comments
SA-1 Upstream of King St SPS	Existing	Not sensitive	Local	
SA-2 – Alt B Dalewood	Existing	Minor Sensitivity	Local	Capacity constraint and upstream backwater (300 mm pipe D/S of Dalewood Dr in easement & GRCA property)
SA-3 Upstream of Spring Valley SPS	Existing	Not sensitive	Trunk	
SA-6 – Alt A Homer Watson	Existing	Minor Sensitivity	Local	Capacity constraint and backwater on sewers, including pipes on private property
SA-7 Sandrock Trunk	Existing	**Significant Sensitivity**	Trunk	Backwater and HGL issues on trunk & local sewers requiring significant additional upgrade(s), including pipes on private properties
SA-8 Upstream of Shirley SPS	Existing	Not sensitive	Trunk	
SA-16 Downstream of New Dundee SPS	Existing	Not sensitive	Local	

Problem Area	Existing vs. New Problem Area	Solutions Sensitivity in Climate Change Event	Trunk vs. Local	Comments
SA-9 Downstream of Manchester SPS	Existing	**Significant Sensitivity**	Trunk	Shallow & flat pipes restrict current solution; would require several additional upgraded and dropped sewer lengths
CC-SA-1 Brentwood Ave	New	Minor Sensitivity	Local	Backwater and HGL issues on local sewers requiring minor upgrades
CC-SA-2 Upstream of Conestoga Siphon	New	**Significant Sensitivity**	Trunk	Significant upgrades required along trunk (includes PKWY crossing); tied with solutions required downstream of Conestoga Siphon (CC-SA-3)
CC-SA-3 Downstream of Conestoga Siphon	New	Minor Sensitivity	Trunk	Significant upgrades required along trunk; tied with solutions required upstream of Conestoga Siphon (CC-SA-2)
CC-SA-4 Guerin/Jansen	New	Minor Sensitivity	Local	Backwater and HGL issues on local sewers requiring minor upgrades
CC-SA-5 Conestoga PKWY	New	**Significant Sensitivity**	Trunk	Significant upgrades required to reduce backwater and HGL issues on trunk & local sewers; includes PKWY crossing Separate (upstream) from CC-SA-2 & CC-SA-3
CC-SA-6 Highview Dr	New	**Significant Sensitivity**	Local	Significant upgrades required to reduce backwater and HGL issues on local sewers upstream of Sandrock (SA-7), including pipes on private properties
CC-SA-7 Upstream of Bridgeport SPS	New	**Significant Sensitivity**	Trunk	SPS upgrades required to eliminate SPS flooding and resulting upstream backwater and HGL issues
Note: "CC-SA-#" refers to new sanitary problem areas observed due to climate change ("CC") impacts only, i.e., in addition to the previously identified capacity-based "SA" solutions.				

While some sensitivities are observed, no changes or additional proposed solutions are recommended at this time considering the uncertainty involved with not only climate change predictions, but also accurate growth predictions for the 2051 horizon. Alternatives regarding additional/continual data acquisitions, flow monitoring and I/I mitigation programs can help reduce sensitivities in these areas instead. See **Section 4.4** for further discussions on Alternative 4.

535000 537500 540000 542500 545000 547500 550000 552500

4815000 4812500 4810000 4807500 4805000 4802500

N

FALCONRIDGE PS
CC-SA-7
BRIDGEPORT REGIONAL PS
TOWNSHIP OF WOOLWICH
SHIRLEY PS
CITY OF WATERLOO
OXFORD PS
SPRING VALLEY PS
CC-SA-5
CARSON PS
OTTERBEIN PS
MOORE AVE PS
MANCHESTER PS
CC-SA-2
SA-9
SPRINGMOUNT PS
CC-SA-1
APPLE TREE PS
WOOLNER TRAIL PS
PATRICIA PS
SA-2
BANCROFT PS
STOKE PS
CC-SA-4
CITY OF CAMBRIDGE
SA-7
CC-SA-3
CHANDOS PS
SA-6
KING St SP
RIVER BIRCH PS
CC-SA-6
PIONEER TOWER PS
NATHALIE PS
WTP
NEW OLD MILL PS
CITY OF KITCHENER
TOWNSHIP OF WILMOT
HOMER WATSON PS
CONESTOGA COLLEGE PS
NEW DUNDEE PS
TOWNSHIP OF NORTH DUMFRIES

535000 537500 540000 542500 545000 547500 550000 552500

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Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Other Sewers
- Forcemain

HGL Freeboard

- Within Basement Level (Within 1.8 m or Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

1:62,500 (At original document size of 11x17)

Notes

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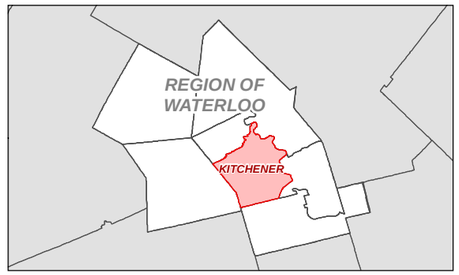


Project Location
City of Kitchener

165640334 REVA
Prepared by EH on 2023-09-20

Client/Project
CITY OF KITCHENER
INTEGRATED SANITARY MASTER PLAN

Figure No.
4.3

Title
Capacity-Based Solutions Sensitivity – 25-Year Climate Change HGL & Surcharge Results

4.3.3 Condition-Based Solutions

As discussed in **Section 2.2**, the CCTV scores provided in the City's asset management data were used to define sewers in poor condition and thus identify those considered for asset renewal. A total of 108 gravity sewers were found to have CCTV scores of 4 or greater and fall within the other defined criteria (see **Section 2.2.1**, equating to 7.1 km of sewer length. These sewers are compiled into 78 renewal projects based on proximity, and are documented in **Table 4-4** by Project ID, where "AR" refers to Asset Renewal. Their relevant Problem Area IDs are also included in the table for easy reference to **Table 2-5** in **Section 2.2.2**, along with the estimated Opinion of Probable Cost per project.

The solution projects are ordered based on the criticality associated with the current CCTV score (higher scores warrant higher prioritization). If CCTV scores are equal, the prioritization is assumed equal. The solution projects are also ordered from trunk to local sewer. All sewer asset renewal projects are identified for near-term solution development (2024 - 2027). For the condition-based sewer projects, the repair required is uncertain as the work is solely based on a CCTV score. Hence, the corrective action could be a simple spot repair on one section of pipe, relining of the pipe, or it could be a full pipe replacement. Therefore, the cost estimates were calculated for all three scenarios with a suggested budget amount between the high and low amounts based on 75% of the cost range. Ongoing data acquisition programs discussed in **Section 4.4** will be used to continually update this list for medium- and long-term asset renewal scheduling.

In addition to the recommended sewer asset renewal projects, the proposed sanitary pumping station asset renewals from RJ Burnside's Conditions Assessment Reports have been incorporated, along with updated OPCs for the City's budgeting purposes, compiled in **Table 4-5**. The budget for the sanitary pumping station asset renewals was adjusted by the City, thus the adjusted budget per City direction is also presented in the table. Moreover, SCADA systems upgrades due to National Fire Protection Association (NFPA) requirements was needed for some of the sanitary pumping station as part of the capital projects. **Table 4-6** compiles the SPS with SCADA systems upgrades along with updated OPCs for the City's budgeting purposes.

The OPCs are considered Class D estimates (+/- 25-30%) and are provided based on 2022 dollars. These OPCs can be used to help inform the City's budgeting process that occurs every 4 years. Thus, all near-term projects should be included within this year's budget. The total recommended budgetary estimates for sewer asset renewals totals approximately $38,033,200, while the pumping station asset renewals adjusted per City direction equates to roughly $2,233,300, and the pumping station SCADA system update totals approximately $1,678,000; the overall total is $48,547,200.

Refer to **Figure 2-10** for the locations of these Asset Renewal projects.

Table 4-4: Sewer Asset Renewal Projects (Near-Term)

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-1	AC-4	Ottawa St N, Dreger Ave, Graber Pl	19x 675 mm sewers on Ottawa St N, Dreger Ave, and Graber Pl between Old Chicopee Dr and just upstream of Conestoga Pkwy	101611, 101612, 101613, 101365, 101366, 101367, 101368, 101335, 101339, 101340, 101341, 101342, 101350, 101351, 101352, 101849, 101850, 101851, 101852	Trunk	5	$2,747,000	$137,350	$2,884,350	$2,884,400
AR-2	AC-7	Rock Ave	1x 525 mm sewer at the end of Rock Ave through private ICI property located between Belmont Ave W and the throughway behind the ICI buildings	105256	Trunk	5	$395,000	$19,750	$414,750	$414,800

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-3	AC-5	Greenbrook Dr	2x 375 mm sewers on Greenbrook Dr between Birchcliffe Ave to just north of Stonybrook Dr	108513, 108404	Trunk	4.5	$595,000	$29,750	$624,750	$624,800
AR-4	AC-1	Vanier Dr	1x 375 mm sewer through easement between Vanier Dr and Clark Ave	118182	Trunk	4.1	$267,000	$13,350	$280,350	$280,400
AR-5	AC-6	Greenbrook Dr	Downstream of AC-8; 1x 900 mm sewer on Greenbrook Dr within Stirling Ave S intersection	107730	Trunk	4.1	$336,000	$16,800	352800	$352,800
AR-6	AC-2	Westforest Trl	1x 375 mm sewer on Westforest Trl between Westmeadow Dr and Hidden Creek Dr	110504	Trunk	4	$322,000	$16,100	338100	$338,100
AR-7	AC-3	Bankside Dr	1x 450 mm sewer on Bankside Dr between Golden Terrace Crt and Eastforest Trl	109989	Trunk	4	$279,000	$13,950	$292,950	$293,000
AR-8	AC-8	West of Connaught Pl	1x 400 mm sewer in easement between Connaught Pl and Conestoga Pkwy	100263	Trunk	4	$646,000	$32,300	$678,300	$678,300

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-9	AC-11	Highbrook Ct	1 x 200 mm sewer on Highbrook Ct between Fisher-Hallman Rd and Highbrook St	119059	Local	5	$303,000	$15,150	$318,150	$318,200
AR-10	AC-13	Woolwich St	1 x 200 mm sewer on Woolwich St between Hillcrest Ln and Bridle Trail	110889	Local	5	$486,000	$24,300	$510,300	$510,300
AR-11	AC-38	Overlea Dr	1 x 250 mm sewer at the intersection of Overlea Dr and Overlea Crescent	108477	Local	5	$391,000	$19,550	$410,550	$410,600
AR-12	AC-20	Block Line Rd	1 x 200 mm sewer on Northmanor Crescent between Resurrection Dr and University Ave W	108196	Local	5	$418,000	$20,900	$438,900	$438,900
AR-13	AC-23	Conestoga Pkwy Onramp	1 x 200 mm sewer on Conestoga Pkwy Onramp between Courtland Ave E and Conestoga Pkwy	107094	Local	5	$781,000	$39,050	$820,050	$820,100
AR-14	AC-46	Highland Crescent	1 x 250 mm sewer on Highland Crescent between Highland Rd and Westmount Rd	106442	Local	5	$361,000	$18,050	$379,050	$379,100

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-15	AC-25	Spring Valley SPS	1 x 250 mm incoming pipe North of Spring Valley SPS	105863	Local	5	$322,000	$16,100	$338,100	$338,100
AR-16	AC-26	Cameron St N	1 x 200 mm sewer on Cameron St N between Duke St E and Weber St E	104745	Local	5	$491,000	$24,550	$515,550	$515,600
AR-17	AC-28	McLeod Ct	1 x 200 mm sewer at the intersection of McLeod Ct and Biehn Dr	103960	Local	5	$241,000	$12,050	$253,050	$253,100
AR-18	AC-29	Gateway Park Dr	3 x 300 mm sewer on Gateway Park Dr between Sportsworld Dr and Tu-Lane St	103769, 103770, 103771	Local	5	$1,462,000	$73,100	$1,535,100	$1,535,100
AR-19	AC-55	Old Mill Rd	1 x 300 mm sewer on Old Mill Rd between Sydenham St and Pinnacle Dr	103117	Local	5	$486,000	$24,300	$510,300	$510,300
AR-20	AC-59	Lower Canada Crescent	1 x 250 mm sewer at the intersection of Lower Canada Crescent and Upper Canada Dr	102928	Local	5	$180,000	$9,000	$189,000	$189,000
AR-21	AC-62	Heritage Dr	1 x 250 mm sewer on Heritage Dr between Keewatin Ave and Lorraine Ave	102226	Local	5	$437,000	$21,850	$458,850	$458,900

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-22	AC-65	King St E	1 x 200 mm sewer on King St E between Sydney St S and Ottawa St S	101278	Local	5	$527,000	$26,350	$553,350	$553,400
AR-23	AC-70	Broadview Ave	1 x 250 mm sewer on Broadview Ave between Broadview Ct and Shuh Ave	100776	Local	5	$352,000	$17,600	$369,600	$369,600
AR-24	AC-72	Greenfield Ave	1 x 250 mm sewer at the intersection of Greenfield Ave and Kingsway Dr	100602	Local	5	$451,000	$22,550	$473,550	$473,600
AR-25	AC-76	Traynor Ave	1 x 250 mm sewer at the intersection of Wilson Ave and Traynor Ave	100075	Local	5	$399,000	$19,950	$418,950	$419,000
AR-26	AC-53	Manitou Dr	2 x 250 mm sewer on Manitou Dr between Fairway Rd S and Webster Rd	103436, 100040	Local	5, 4	$997,000	$49,850	$1,046,850	$1,046,900
AR-27	AC-35	Driftwood Dr	1 x 200 mm sewer on Driftwood Dr between Parkland Crescent and Toynbee Crescent	109901	Local	4.5	$442,000	$22,100	$464,100	$464,100

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-28	AC-39	Stonybrook Dr	1 x 225 mm sewer on Stonybrook Dr between Village Crescent and Sweetbriar Dr	108398	Local	4.5	$441,000	$22,050	$463,050	$463,100
AR-29	AC-45	Selkirk Ct	1 x 200 mm sewer on Selkirk Ct between Selkirk Dr and Geneva Crescent	107224	Local	4.5	$395,000	$19,750	$414,750	$414,800
AR-30	AC-9	Richmond Avenue	1 x 250 mm sewer on Richmond Avenue between Water St S and David St	2002189	Local	4	$247,000	$12,350	$259,350	$259,400
AR-31	AC-10	Huck Crescent	1 x 200 mm sewer on Huck Crescent between Udvari Crescent and Keller Crescent	119495	Local	4	$297,000	$14,850	$311,850	$311,900
AR-32	AC-12	Deep Ridge Dr	1 x 200 mm sewer on Deep Ridge Dr between Candle Crescent and Grand Hill Dr	118447	Local	4	$579,000	$28,950	$607,950	$608,000
AR-33	AC-32	Alpine Rd	1 x 250 mm sewer on Alpine Rd between Kingswood Dr and Homer Watson Blvd	118286	Local	4	$369,000	$18,450	$387,450	$387,500

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-34	AC-33	Hollinger Crescent	1 x 250 mm sewer on Hollinger Crescent between Bridge St E and Dumart Pl	111001	Local	4	$423,000	$21,150	$444,150	$444,200
AR-35	AC-14	Northmanor Crescent	1 x 200 mm sewer on Northmanor Crescent between Resurrection Dr and University Ave W	110709	Local	4	$336,000	$16,800	$352,800	$352,800
AR-36	AC-15	Windward Pl	1 x 250 mm sewer on Windward Pl between Keller Crescent and Westforest Trail	110658	Local	4	$425,000	$21,250	$446,250	$446,300
AR-37	AC-34	Stoke Dr	1 x 200 mm sewer on Stoke Dr between Wexford Crescent and Monarch Woods	110577	Local	4	$444,000	$22,200	$466,200	$466,200
AR-38	AC-16	Westforest Trail	1 x 200 mm sewer on Westforest Trail between Shadyridge Pl and Beechcroft Pl	110528	Local	4	$461,000	$23,050	$484,050	$484,100
AR-39	AC-17	Dawn Ridge Dr	1 x 200 mm sewer Dawn Ridge Dr on between Westmeadow Dr and Westforest Trail	110522	Local	4	$406,000	$20,300	$426,300	$426,300

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-40	AC-36	Fisher-Hallman Rd	1 x 250 mm sewer on Fisher-Hallman Rd between Highland Rd W and Queen's Blvd	108906	Local	4	$544,000	$27,200	$571,200	$571,200
AR-41	AC-37	Westheights Dr	1 x 300 mm sewer through private property located on Westheights Dr	108878	Local	4	$654,000	$32,700	$686,700	$686,700
AR-42	AC-40	Barberry Pl	1 x 225 mm sewer on Barberry Pl between Westmount Rd and Forest Hill Dr	108347	Local	4	$412,000	$20,600	$432,600	$432,600
AR-43	AC-18	Marlis Crescent	1 x 200 mm sewer on Marlis Crescent between Bleams Rd and Erinbrook Dr	108258	Local	4	$216,000	$10,800	$226,800	$226,800
AR-44	AC-19	Highbrook St	1 x 200 mm sewer on Highbrook St between Highbrook St and Westmount Rd E	108216, 108203	Local	4	$679,000	$33,950	$712,950	$713,000
AR-45	AC-21	Ristau Crescent	1 x 200 mm sewer on Ristau Crescent between Highbrook Crescent and Dinison Crescent	108056	Local	4	$557,000	$27,850	$584,850	$584,900

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-46	AC-41	Sandsprings Crescent	2 x 200 mm sewer on Sandsprings Crescent between Devonglen Dr and Sandsprings Ct	107604, 107656	Local	4	$503,000	$25,150	$528,150	$528,200
AR-47	AC-42	Cherry Hill Dr	1 x 250 mm sewer on Cherry Hill Dr between Coach Hill Dr and Murrayhill Ct	107321	Local	4	$232,000	$11,600	$243,600	$243,600
AR-48	AC-43	Coach Hill Dr	1 x 250 mm sewer on Coach Hill Drbetween Cherry Hill Dr and Block Line Rd	107318	Local	4	$607,000	$30,350	$637,350	$637,400
AR-49	AC-44	Coach Hill Dr	1 x 250 mm sewer on Coach Hill Dr between Cherry Hill Dr and Homer Watson Blvd	107306	Local	4	$371,000	$18,550	$389,550	$389,600
AR-50	AC-22	Ottawa St S	1 x 200 mm sewer on Ottawa St S between McLennan Park Gate and Strasburg Rd	107118	Local	4	$406,000	$20,300	$426,300	$426,300
AR-51	AC-24	Bedford Rd	2 x 200 mm sewer on Bedford Rd between Sydney St S and Schneider Creek	106954, 106955	Local	4	$341,000	$17,050	$358,050	$358,100

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-52	AC-47	Paulander Dr	2 x 250 mm sewer on Paulander Dr between Victoria St S and Lawrence Ave	106329, 106334	Local	4	$552,000	$27,600	$579,600	$579,600
AR-53	AC-48	Weichel St	1 x 250 mm sewer on Weichel St between Belton Dr and Karn St	106299	Local	4	$444,000	$22,200	$466,200	$466,200
AR-54	AC-49	Belmont Ln W	1 x 250 mm sewer on Belmont Ln W between Claremont Ave and Argyle St	106083	Local	4	$458,000	$22,900	$480,900	$480,900
AR-55	AC-50	Union Blvd	1 x 250 mm sewer on Union Blvd between Earl St and Severn Ave	106063	Local	4	$319,000	$15,950	$334,950	$335,000
AR-56	AC-51	Guelph St	1 x 250 mm sewer parallel to the Spur Line Trail and connect to Guelph St sewer	105106	Local	4	$409,000	$20,450	$429,450	$429,500
AR-57	AC-27	Breithaupt St	1 x 200 mm sewer on Breithaupt St between Moore Ave and Waterloo St	104435	Local	4	$252,000	$12,600	$264,600	$264,600

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-58	AC-52	Wheatfield Crescent	1 x 200 mm sewer on Wheatfield Crescent between Pathfinder Crescent and Bechtel Dr	103885	Local	4	$226,000	$11,300	$237,300	$237,300
AR-59	AC-54	Upper Canada Dr	1 x 250 mm sewer through private residential property located between Farrier Dr and Upper Canada Dr	103415	Local	4	$405,000	$20,250	$425,250	$425,300
AR-60	AC-56	Old Mill Rd	1 x 200 mm sewer on Old Mill Rd between Mill Park Dr and Rose St	103108	Local	4	$346,000	$17,300	$363,300	$363,300
AR-61	AC-57	Arrowhead Crescent	2 x 250 mm sewer on Arrowhead Crescent between Homer Watson Blvd and Green Valley Dr	103052, 103053	Local	4	$508,000	$25,400	$533,400	$533,400
AR-62	AC-58	Green Valley Dr	1 x 250 mm sewer on Green Valley Dr between Pioneer Dr and Arrowhead Crescent	103041	Local	4	$401,000	$20,050	$421,050	$421,100

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-63	AC-30	Brembel St	1 x 200 mm sewer through private residential complex located between Brembel St and Ottawa St N	102507	Local	4	$308,000	$15,400	$323,400	$323,400
AR-64	AC-31	Denlow St	1 x 200 mm sewer on Denlow St between Brembel St and Rose Garden St	102499	Local	4	$301,000	$15,050	$316,050	$316,100
AR-65	AC-60	Dumfries Ave	1 x 225 mm sewer on Dumfries Ave between Chapel St and Krug St	102355	Local	4	$479,000	$23,950	$502,950	$503,000
AR-66	AC-61	Heritage Dr	1 x 200 mm sewer on Heritage Dr between Lorraine Ave and Oakhurst Crescent	102231	Local	4	$574,000	$28,700	$602,700	$602,700
AR-67	AC-63	Nipigon St	1 x 250 mm sewer on Nipigon St between Nipigon Pl and Georgian St	102207	Local	4	$576,000	$28,800	$604,800	$604,800
AR-68	AC-64	Burbank Rd	1 x 200 mm sewer on Burbank Rd between Conestoga Pkwy and Ada St	101738	Local	4	$295,000	$14,750	$309,750	$309,800

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-69	AC-66	Wyandotte Ct	1 x 250 mm sewer in Morrison Park between Wyandotte Ct and Oneida Pl	100995	Local	4	$499,000	$24,950	$523,950	$524,000
AR-70	AC-67	Morrison Road	1 x 250 mm sewer on Morrison Road between Quinte Crescent and Grand River Blvd	100981	Local	4	$204,000	$10,200	$214,200	$214,200
AR-71	AC-68	Morrison Road	2 x 200 mm sewer on Morrison Road between mm sewer between Quinte Crescent and Grand River Blvd	100972, 100973	Local	4	$699,000	$34,950	$733,950	$734,000
AR-72	AC-69	Burgetz Ave	1 x 250 mm sewer on Burgetz Ave between River Rd E and Thaler Ave	100921	Local	4	$343,000	$17,150	$360,150	$360,200
AR-73	AC-71	Siebert Ave / Courtland Ave E	1 x 250 mm sewer at the intersection of Siebert Ave and Courtland Ave E	100628	Local	4	$283,000	$14,150	$297,150	$297,200
AR-74	AC-73	Broadmoor Ave	1 x 200 mm sewer at the intersection of Broadmoor Ave and Clark Ave	100324	Local	4	$340,000	$17,000	$357,000	$357,000

Project ID	Asset Condition ID	Project Name	Project Description	Pipe Asset IDs	Sewer	Average CCTV Score	Estimated Opinion of Probable Cost	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
AR-75	AC-74	Hillmount St	1 x 250 mm sewer at the intersection of Hillmount St and Shelley Dr	100304	Local	4	$226,000	$11,300	$237,300	$237,300
AR-76	AC-75	Carrol St	1 x 250 mm sewer on Carrol St between Connaught St and Greenfield Ave	100146	Local	4	$304,000	$15,200	$319,200	$319,200
AR-77	AC-77	Hazen Glen Dr / Ingleside Dr	2 x 250 mm sewer on Hazen Glen Dr and Ingleside Dr	110736, 110759	Local	4, 5	$311,000	$15,550	$326,550	$326,600
AR-78	AC-78	Union St	2 x 225 mm sewer on Union St	104911, 106005	Local	4	$699,000	$34,950	$733,950	$734,000
						Sub-Totals	**$36,220,000**	**$1,811,000**	**$38,031,000**	**$38,033,200**
						Total	**$38,033,200**			

Table 4-5: Sanitary Pumping Station Asset Renewal Projects

Horizon	Budget from the RJ Burnside's Conditions Assessment Reports	Budget adjusted per City Direction
Short Term Projects (2024 - 2027)	$3,902,008	$444,000
Medium Term Projects (2028 - 2031)	$5,390,522	$1,193,000
Long Term Projects (2032 - 2051)	-	$596,259
Total	**$9,292,600**	**$2,233,300**

Table 4-6: Sanitary Pumping Station Scada System Upgrades

Pumping Station	Estimated Opinion of Probable Construction Cost (Base Year 2022)	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
Apple Tree SPS	$157,985	$7,899	$165,884	$166,000
Bancroft SPS	$11,673	$584	$12,257	$12,000
Carson SPS	$11,673	$584	$12,257	$12,000
Chandos SPS	$283,778	$14,189	$297,967	$298,000
Conestoga College SPS	$157,985	$7,899	$165,884	$166,000
Falconridge SPS	$299,308	$14,965	$314,273	$314,000
King Street SPS	$88,203	$4,410	$92,614	$93,000
New Dundee SPS	$11,673	$584	$12,257	$12,000
Oxford SPS	$124,839	$6,242	$131,081	$131,000
Patricia SPS	$72,332	$3,617	$75,948	$76,000
River Birch SPS	$157,985	$7,899	$165,884	$166,000
Springmount SPS	$11,673	$584	$12,257	$12,000

Pumping Station	Estimated Opinion of Probable Construction Cost (Base Year 2022)	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate
Stoke SPS	$33,801	$1,690	$35,491	$35,000
Shirley SPS	$11,673	$584	$12,257	$12,000
Woolner SPS	$164,684	$8,234	$172,918	$173,000
			Total	**$1,678,000**

4.4 ALTERNATIVE 4 – DATA ACQUISITION, FLOW MONITORING AND I/I MITIGATION PROGRAMS

4.4.1 Sanitary Trunk Sewer & Forcemain Condition Data Acquisition Program

As discussed in **Sections 2.2** and **4.3.3**, the City provided their latest CCTV datasets (current up to August 2022) for review and to establish condition-based (asset renewal) sanitary projects. Through correspondence with the City, it was determined that the previously provided Total Wastewater Priority Assessment Score (TWPAS) data should not be relied upon due to redundancy with CCTV data scoring and vintage of the TWPAS scoring methodology and dataset. While the review of CCTV data helps establish the asset renewal project list (**Section 4.3.3**), it also supports the opportunity for the City to review, revamp and focus City's CCTV program based on priority assets.

As discussed in **Section 2.3.1**, innovative methodologies are available for inspecting forcemains, such as the SmartBall technology, which consists of a tethered inspection tool that travels with the flow of the pipe while simultaneously collecting data. This technology can be used to understand pipe condition, detect leaks, and validate existing GIS data, and is a viable technique for forcemain condition data collection as part of this program.

Additional criteria are applied to establish a list of trunk sewers and forcemains within the system that or have outdated condition datasets. Stantec has reviewed the available CCTV data with focus on sanitary gravity sewers and forcemains to provide the City with near-term, medium-term and long-term CCTV data acquisition needs through their Sanitary Trunk Sewer CCTV Program. The City provided additional near-term projects for local sewers. The following criteria relate to the review and categorization of the available CCTV data to establish program priorities:

- For gravity pipes, only trunks are included, which is defined by sewers with diameters 375 mm and greater, with gaps filled in to include the full sewer "leg".
- All forcemains in the pipe network are included.
- Only pipes and forcemains with Kitchener or Dual City & Region ownership categories are considered.
- Near-term Pipe Replacements/Relining are considered if CCTV scores are greater than or equal to 4, and the pipe is not already scheduled for a Capacity-Based Project, or Reconstruction/Relining (as defined by the City per December 7, 2022 correspondence).
- CCTV Scores include the updated Structural Grades (where 4 or greater) completed as part of the Ottawa Street Sanitary Trunk Sewer Condition Assessment and Rehabilitation Recommendation report, dated November 2022.
- CCTV Data is considered Outdated & requires Near-Term Action if:
    - Pipe Age >= 25yrs OR Unknown & Last CCTV >= 6yrs ago OR Unknown
- CCTV Data is considered Outdated & requires Medium-Term Action if:
    - Pipe Age >= 25yrs old OR Unknown & Last CCTV < 6yrs ago

  - Pipe Age >= 6yrs old but < 25yrs & Last CCTV >= 6yrs ago

- CCTV Data is considered Outdated & requires Long-Term Action if:
  - Pipe Age >= 6yrs old but < 25yrs & Last CCTV < 6yrs ago
  - Pipe Age < 6yrs old
- Outdated CCTV data is defined as CCTV data that is greater than 6yrs old. This is because the CCTV data will be 10 years old at the end of a 4-year multi-year budget cycle, which is considered outdated by municipalities of similar scale.

The result of the programmatic CCTV data review is provided in **Table 4-7**, indicating near-term CCTV investigation for 919 gravity pipes (66.7 km) and 9 forcemain pipes (6.7 km).

Refer to **Appendix C** for a list of all pipes recommended for near-, medium-, and long-term CCTV data acquisitions.

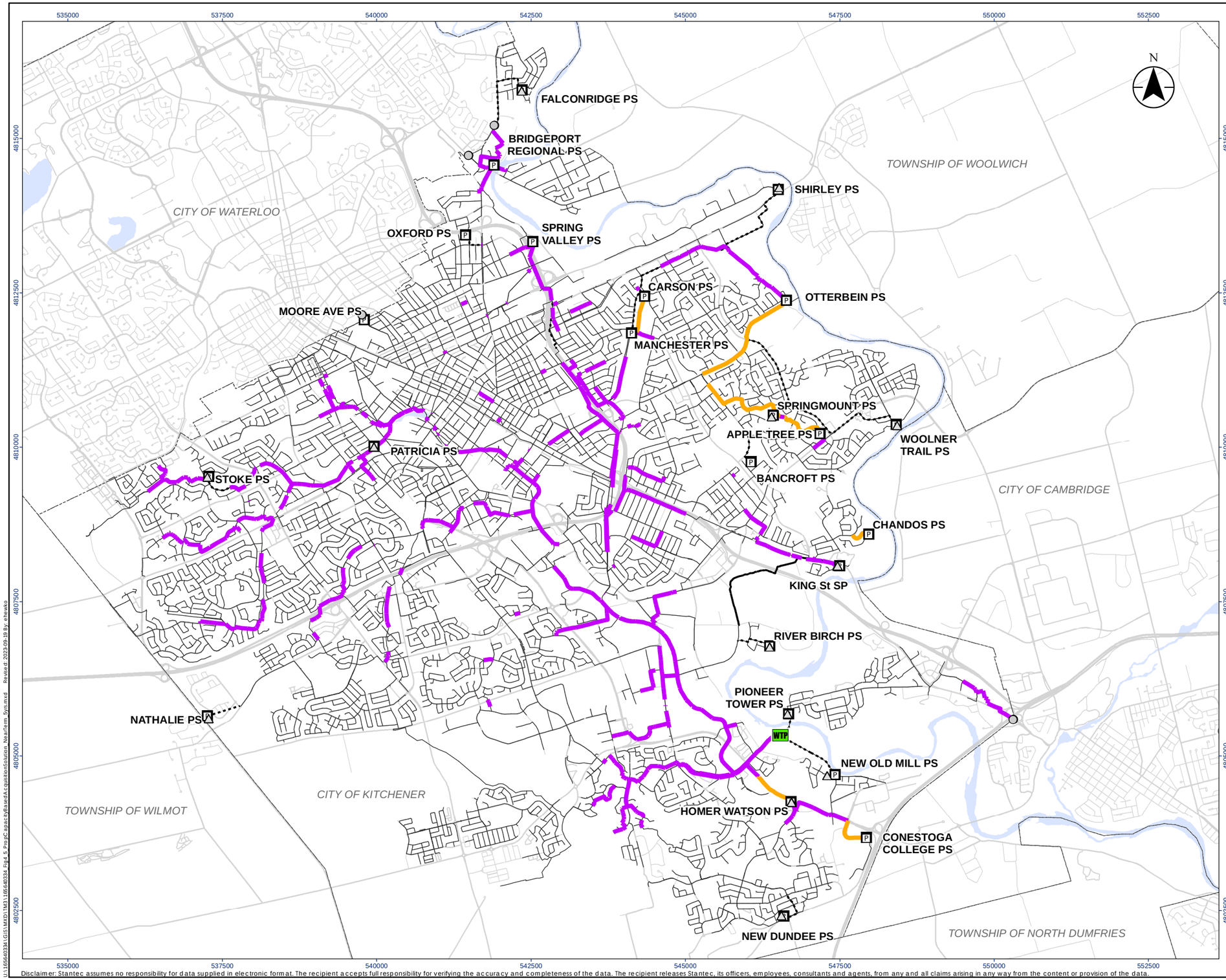
Table 4-7: Conditions Data Review

Project Type	Proposed Horizon	Conduit Type	Condition Score	Status	Clay/ Asbestos Material	Total No. of Pipes	Total Length of Pipes (km)	No. of Project Pipes	Total Project Length (km)
Pipe Replacements/ Relining	Near-term (4yrs)	Gravity	4 ≤ CCTV ≤ 5	N/A	N/A	104	6.9	104	6.9
		Forcemain	4 ≤ CCTV ≤ 5	N/A	N/A	-	-	-	-
Data Acquisition	Near-term (4yrs)	Gravity	CCTV < 4	CCTV Outdated	N	1,863	123.4	648	48.2
	Near-term (4yrs)				Y			271	18.5
	Medium-term (5-8yrs)				N			631	38.6
	Medium-term (5-8yrs)				Y			74	4.7
	Long-term (>8yrs)				N			236	13.4
	Long-term (>8yrs)				Y			3	0.0
	Near-term (4yrs)	Forcemain	Condition < 4	Outdated	N	25	17.5	8	6.1
	Near-term (4yrs)				Y			1	0.6
	Medium-term (5-8yrs)				N			14	10.5
	Medium-term (5-8yrs)				Y			-	-
	Long-term (>8yrs)				N			2	0.4
	Long-term (>8yrs)				Y			-	-

Based on industry standards within Southwestern Ontario, the cost for CCTV investigation, including pre-cleaning (flushing), is conservatively estimated at $6.00 per meter. The associated cost for the near-term CCTV program works as outlined above is provided in **Table 4-8**. With a total 4-year program budget estimate of $1,317,000, and the annualized program budget for near-term CCTV and Smartball technology programs is estimated present in **Appendix D**.

Table 4-8: Data Acquisition

			Total length (m)	Estimated Cost ($/m)	Recommended Budgetary Estimate[1]
Trunk Sewer Condition Assessment		CCTV for all trunk sewers (>375 mm dia.) for pipes which are greater than 25 yrs age. CCTV cycle is every 10 yrs.	$66,700	$6.00	$541,000
Forcemain Condition Assessment		SmartBall technology for all forcemains which are greater than 25 yrs age. SmartBall technology cycle is every 10 yrs.	-	-	$776,000[2]
				Total	**$1,317,000**
*Does not include hot spot flushing					
1- Includes contingency allowance (20%) and engineering review (15%) 2- Cost is generated based on completing 5 forcemains per year with the work being completed on all 5 as one operation.					



Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Other Sewers
- Forcemain
- Condition-Based Data Acquisition - Gravity Sewer
- Condition-Based Data Acquisition - Forcemain

0 1 2 km

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Notes

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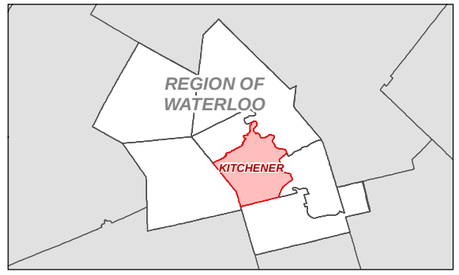


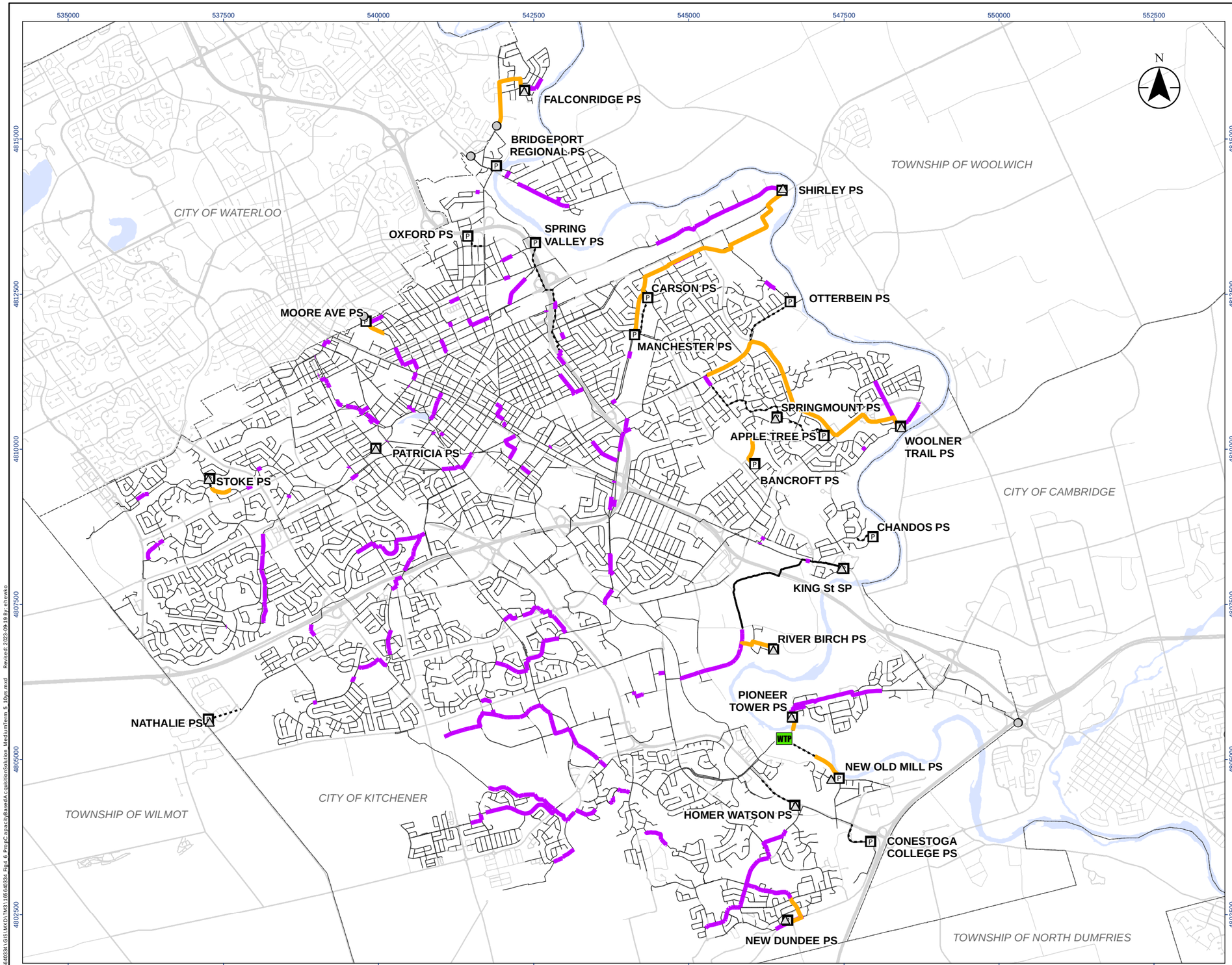
Project Location
City of Kitchener

165640334 REVA
Prepared by EH on 2023-09-19

Client/Project
CITY OF KITCHENER
INTEGRATED SANITARY MASTER PLAN

Figure No.
4.4

Title
Proposed Condition-Based Data Acquisition Solutions – Near-Term (5 Years)



Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Other Sewers
- Forcemain
- Condition-Based Data Acquisition - Gravity Sewer
- Condition-Based Data Acquisition - Forcemain

0 1 2 km

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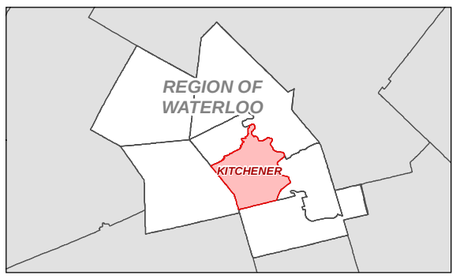


Project Location
City of Kitchener

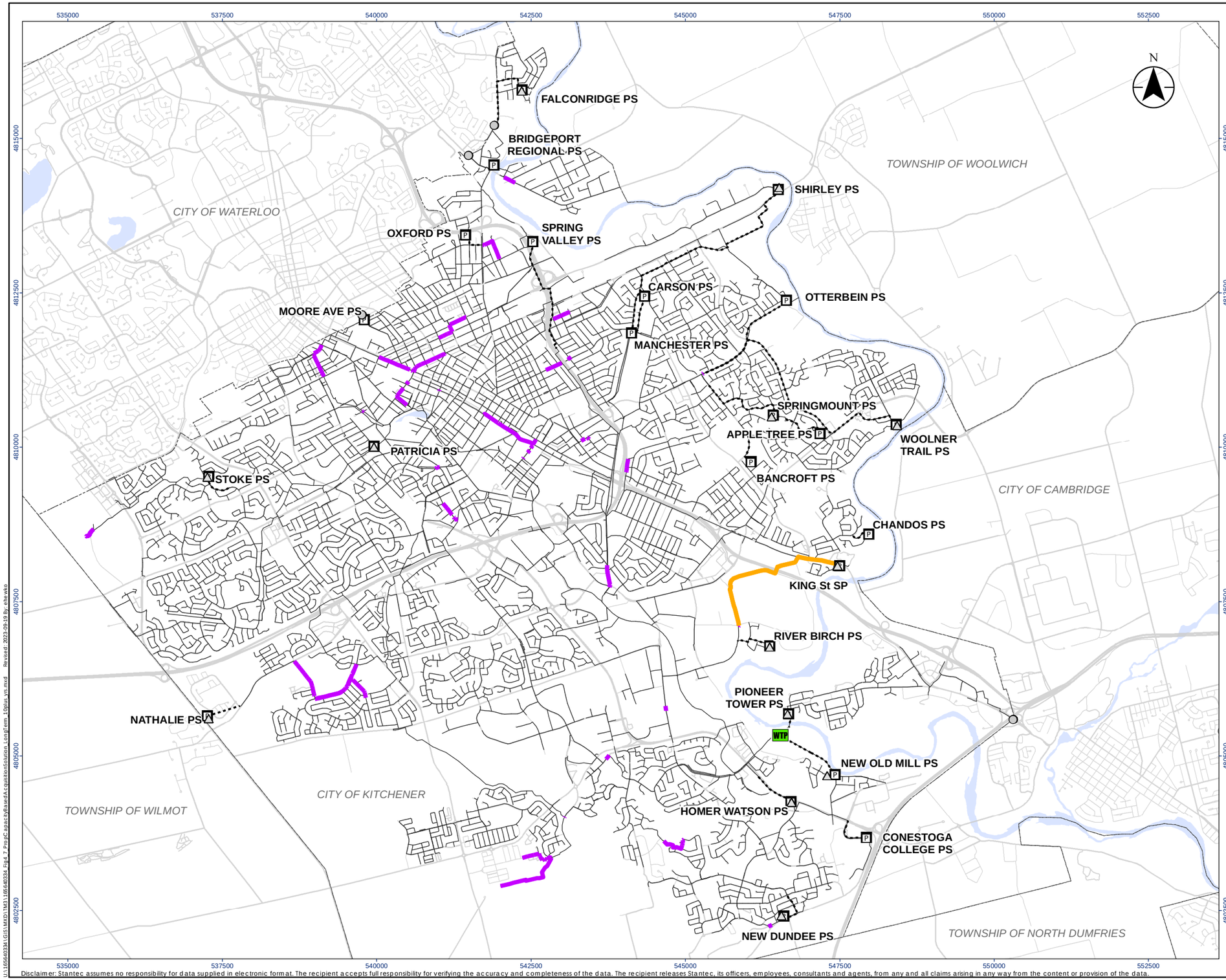
165640334 REVA
Prepared by EH on 2023-09-19

Client/Project
CITY OF KITCHENER
INTEGRATED SANITARY MASTER PLAN

Figure No.
4.5

Title
Proposed Condition-Based Data Acquisition Solutions – Medium-Term (5 - 10 Years)

U:\165640334\GIS\MXD\TM3\165640334_Fig4_6_ProjCapacityBasedAcquisitionSolution_MediumTerm_5_10yrs.mxd Revised: 2023-09-19 By: ehewko



Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Other Sewers
- Forcemain
- Condition-Based Data Acquisition - Gravity Sewer
- Condition-Based Data Acquisition - Forcemain

0 1 2 km

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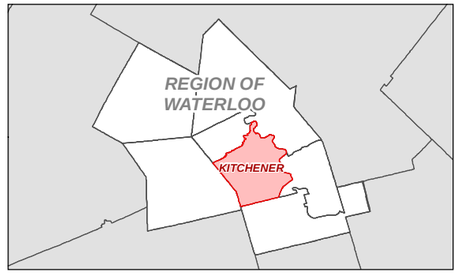


Project Location
City of Kitchener

165640334 REVA
Prepared by EH on 2023-09-19

Client/Project
CITY OF KITCHENER
INTEGRATED SANITARY MASTER PLAN

Figure No.
4.6

Title
Proposed Condition-Based Data Acquisition Solutions – Long-Term (>10 Years)

U:\165640334\GIS\MXD\TM31\165640334_Fig4_7_ProjectSpecificBasedAcquisitionSolution_LongTerm_10plus_yrs.mxd Revised: 2023-09-19 By: ehewko

4.4.2 Infiltration/Inflow Reduction & Mitigation Programs

The infiltration and inflow (I/I) of extraneous stormwater and groundwater sources into sanitary sewers can overwhelm conveyance capacity and can be a significant cause of surcharge leading to premature pipe deterioration, system backups, basement flooding, and overflows, which can result in unnecessary and significant operating costs for conveying and treating excess groundwater and stormwater and take away capacity that was planned and designed to accommodate future growth. To date, the City of Kitchener has not had a high degree of capacity-related issues in the system and thus measures to address I/I were taken reactively as required in focused areas of the system. Aging infrastructure, illicit cross-connections with the surface, storm sewer or riverine systems, and changes in weather patterns can all contribute to the observed increasing trend in extraneous flow reaching the treatment plant. The total 4-year I/I reduction and mitigation program budget estimate is $3,175,000, with an annualized program budget present in **Appendix D**.

Best in Class municipalities follow the best practices recently outlined in the *Guideline to Developing an Efficient and Cost-Effective Inflow and Infiltration (I/I) Reduction Program: A Foundational Document* (Robinson, B., and Sandink, D. 2021) as available on the Standards Council of Canada website: https://www.scc.ca/en/system/files/publications/Norton-ICLR-SCC_-_Efficient_and_Cost_Effective_I-I_Reduction_Programs_-_2021_EN.pdf. This outlines the base components required to develop an I/I Program, which should be established through development of an I/I Strategy, to define the vision, objectives, program drivers, and alignment to Corporate initiatives, through review and holistic evaluation of inter-departmental operations, opportunities and co-benefits. Comprehensive I/I Programs are synergistically tied to other municipal infrastructure programs such as asset renewal (replacement and/or rehabilitation), capital works planning, operational improvements, and growth management/capacity assurance programs. Establishing, maintaining, and sustaining a successful strategy thus means securing long-term capacity while monitoring and assuring the structural condition of the assets is maintained. On-going data collection, performance monitoring, enforcement of design and construction standards, sewer integrity/condition assessment, hydraulic performance assessments, and overall data management and analytics are all fundamental components within a sustaining and optimized I/I Program.

The long-term vision for a functional I/I Program is tied to digital transformation and implementing Smart City initiatives that are driven by data integration and analytics, which provides for a connected & insightful workforce, enhanced ability to abstract, share, and visualize information, improved ability to analyze and interpret data, and better-informed decision making and program/project execution.

Short-term funding is proposed to develop the I/I Strategy to define the I/I Program, with supporting annual budgetary allowance to initiate and establish the program elements. This program is supported by the proposed Rainfall and Flow Monitoring Program, Hydraulic Model Update & Maintenance Program, and Sanitary Trunk Sewer CCTV Program. It is envisioned that one Full Time Equivalent (FTE) staff member will be required to manage/oversee the establishment of this program including the companion Rainfall and Flow Monitoring Program. A shared FTE is also proposed to support the planning, analysis, and execution of the I/I Program and Rainfall & Flow Monitoring Program.

4.4.3 Rainfall and Flow Monitoring

While the City has a history of collecting rainfall data and flow monitoring programs, these programs have been completed on an as-needed basis and there has not been an overarching plan for targeting or prioritizing monitoring sites or monitoring protocols from which to derive consistency in the work contracted out and the quality and organization of the data received. To support long-term data trending in keeping with the goal of proactive system management, a formal Rainfall and Flow Monitoring Program is recommended for the Sanitary and Stormwater Utilities Division. This program is intended to manage all the rainfall and flow monitoring equipment and contracts, and strategically plan, coordinate, and manage the data collection activities that are fit-for-purpose to support the various Business Drivers and Stressors impacting the existing and future collection system. These include Hydraulic Model maintenance, Infiltration and Inflow Reduction/Mitigation, Operations and Maintenance activities/frequencies, Operational Alarming/Emergency Response/Forensic evaluation, Capital Project planning and design, Asset Management, and Growth Management Planning.

Funding is allocated to the near-term initiation and formalization of a program strategy, to identify the drivers and stressors, complementary program needs/benefits, monitoring scale, type, coverage and priorities, data management needs, and overarching priorities and standards. An annual allowance for this program is based on similar municipal investments scaled to the size of Kitchener. This program is anticipated to be under the same management/oversight and technical support FTEs as noted in the new I/I Program. The near-term Rainfall and Flow Monitoring Program budget estimate is $1,850,000, with an annualized program budget present in **Appendix D**.

4.4.4 Sanitary Hydraulic Model Updates & Maintenance

Best in Class utilities use hydraulic modelling as a key element of their capital planning, operations, and management decision-making activities. Appropriate investment is required in the continual maintenance and upkeep of this important assessment tool. As was noted through the hydraulic model build, calibration, and assessment phases that, while the model is ‘all-pipe’, it has been updated and calibrated at the trunk level based on the limited flow monitoring coverage available through this project. As such, this represents a functional tool for the master planning level, that should be continuously updated and refined based on priority of needs in the areas where no monitoring coverage was available and in the local system. Model maintenance activities will include items such as Physical Network Improvements (based on drawing review, asset data findings, and field investigations), Validation and/or Recalibration (based on ongoing Rainfall and Flow Monitoring Program data collection), and Annual Updates (to reflect changes due to sewer construction or pump station operation, and updates based on population growth/new developments).

The model update and maintenance should incorporate a strategy for the integration of new construction, development approvals, and updated community planning and growth assumptions into the model. This approach is designed to enhance the model’s accuracy in representing future conditions, thereby enabling more informed and strategic decision-making.

An annual allowance for model update and maintenance activities has been defined for initial budgeting purposes, for the systematic and continual update and application of the hydraulic modelling tool. It is recommended that the City undertake annual updates to the model to incorporate new construction, development approvals, updated community planning and growth assumptions into the model. It is assumed this program will be undertaken within the current team of the Sanitary and Stormwater Utilities Division of the Infrastructure Services Department.

Recommended budgetary costs associated with the above noted programs for the near-term estimate is $804,000, with an annualized program budget present in **Appendix D**.

4.4.5 Hydrogen Sulfide Monitoring Program

In sewer systems where anaerobic conditions are present, sulfate-reducing bacteria reduce sulfate to hydrogen sulfide (H_2S), leading to sewer corrosion and odor emission, as outlined in the *Hydrogen sulfide control in sewer systems: A critical review of recent progress* (Liang Zhang,Yan-Ying Qiu,Keshab R. Sharma,Tao Shi,Yarong Song,Jianliang Sun,Zhensheng Liang,Zhiguo Yuan,Feng Jiang, 2023) as available on the website: https://www.sciencedirect.com/science/article/abs/pii/S0043135423004827. Based on this same study, there are various sulfide/corrosion control strategies, including (1) chemical addition to sewage to reduce sulfide formation, to remove dissolved sulfide after its formation, or to reduce H_2S emission from sewage to sewer air, (2) ventilation to reduce the H_2S and humidity levels in sewer air, and (3) amendments of pipe materials/surfaces to retard corrosion. Prior to implementing such strategies, it is important to first understand if H_2S is an issue within the system, and where H_2S is forming such that control strategies can be targeted accordingly. To better understand the presence of H_2S within the existing sanitary system, the proposed approach is to deploy H_2S monitors for a 6-month duration with focus on incoming and outgoing sewers to pumping stations and downstream of siphons, where H_2S is more likely to form. The monitors would be relocated every 6 months to maximize coverage within the system. After 3 years, and when initial target sewers have been monitored, additional H_2S monitoring can be completed based on monitoring results to focus on high H_2S prone areas. The near-term Hydrogen Sulfide Monitoring Program budget estimate is $316,000, with an annualized program budget present in **Appendix D**.

5.0 IMPLEMENTATION PLAN

The implementation plan consists of the timing of projects and data acquisition that was present in the previous sections with the costing adjusted for inflation based on the implementation year. Moreover, the implementation plan spreads the capital works based on criticality to provide an annualized cost for the City's consideration. **Table 5-1** presents the prioritization (with 1 indicating highest priority) and annual costing for the short-term Capital Projects, **Table 5-2** presents the prioritization and annual costing for the medium-term Capital Projects, and **Table 5-3** presents the costing for the Data Acquisition and Management Programs. Additionally, **Table 5-4** presents a summary of the annual costing from 2024 to 2031. Refer to **Sections 4.3** and **4.4** for details on the Capital Projects and the Data Acquisition and Management Programs.

Table 5-1: Short Term Projects (2024 - 2027) Prioritization & Annual Costing

Short Term Project ID	Project Name	Project Type	Recommended Budgetary Estimate	Priority	2024	2025	2026	2027
ST1	Homer Watson	Capacity / Condition	$3,974,000	3	$-	$-	$4,830,422	$-
ST2	Upper Schneider - Sandrock	Capacity	$2,353,000	4	$-	$-	$-	$3,003,091
ST3	Shirley SPS	Capacity	$0	Upgrade to be paid for by Township of Woolwich				
ST4	Moore Ave SPS Decommissioning	Condition	$2,065,000	1	$2,276,663	$-	$-	$-
ST5	Apple Tree SPS	Condition	$166,000	2	$-	$192,166	$-	$-
ST6	Bancroft SPS	Condition	$12,000	2	$-	$13,892	$-	$-
ST7	Carson SPS	Condition	$12,000	2	$-	$13,892	$-	$-
ST8	Chandos SPS	Condition	$298,000	3	$-	$-	$362,221	$-
ST9	Conestoga College SPS	Condition	$166,000	2	$-	$192,166	$-	$-
ST10	Falconridge SPS	Condition	$314,000	3	$-	$-	$381,669	$-
ST11	King Street SPS	Condition	$93,000	1	$102,533	$-	$-	$-
ST12	New Dundee SPS	Condition	$12,000	2	$-	$13,892	$-	$-
ST13	Oxford SPS	Condition	$131,000	2	$-	$151,649	$-	$-
ST14	Patricia SPS	Condition	$76,000	3	$-	$-	$92,378	$-
ST15	River Birch SPS	Condition	$166,000	4	$-	$-	$-	$211,863
ST16	Springmount SPS	Condition	$12,000	2	$-	$13,892	$-	$-
ST17	Stoke SPS	Condition	$35,000	4	$-	$-	$-	$44,670
ST18	Shirley SPS	Condition	$12,000	1	$13,230	$-	$-	$-
ST19	Woolner SPS	Condition	$173,000	2	$-	$200,269	$-	$-

IMPLEMENTATION PLAN
March 18, 2024

Short Term Project ID	Project Name	Project Type	Recommended Budgetary Estimate	Priority	2024	2025	2026	2027
ST20	All Pumping Stations[1]	Condition	$444,000		$18,690	$164,731	$172,968	$181,616
ST21	Vanier	Condition	$280,400	2	$-	$324,598	$-	$-
ST22	Westcrest	Condition	$338,100	2	$-	$391,393	$-	$-
ST23	Bankside	Condition	$293,000	2	$-	$339,184	$-	$-
ST24	Ottawa	Condition	$2,884,400	1	$3,180,051	$-	$-	$-
ST25	Greenbrook Drive	Condition	$624,800	1	$688,842	$-	$-	$-
ST26	Greenbrook Drive	Condition	$352,800	1	$388,962	$-	$-	$-
ST27	Belmont	Condition	$414,800	1	$457,317	$-	$-	$-
ST28	Connaught	Condition	$678,300	2	$-	$785,217	$-	$-
ST29	Richmond	Condition	$259,400	3	$-	$-	$315,302	$-
ST30	Huck	Condition	$311,900	4	$-	$-	$-	$398,072
ST31	Highbrook	Condition	$318,200	2	$-	$368,356	$-	$-
ST32	Deer Ridge	Condition	$608,000	4	$-	$-	$-	$775,979
ST33	Woolwich	Condition	$510,300	2	$-	$590,736	$-	$-
ST34	Northmanor	Condition	$352,800	4	$-	$-	$-	$450,272
ST35	Windward	Condition	$446,300	3	$-	$-	$542,480	$-
ST36	Westforest	Condition	$484,100	4	$-	$-	$-	$617,848
ST37	Dawn Ridge	Condition	$426,300	4	$-	$-	$-	$544,079
ST38	Marius	Condition	$226,800	4	$-	$-	$-	$289,461
ST39	Highbrook	Condition	$713,000	4	$-	$-	$-	$909,989
ST40	Block Line	Condition	$438,900	2	$-	$508,082	$-	$-
ST41	Ristau	Condition	$584,900	2	$-	$677,095	$-	$-
ST42	Ottawa St	Condition	$426,300	4	$-	$-	$-	$544,079

Short Term Project ID	Project Name	Project Type	Recommended Budgetary Estimate	Priority	2024	2025	2026	2027
ST43	Conestoga Parkway	Condition	$820,100	4	$-	$-	$-	$1,046,679
ST44	Bedford	Condition	$358,100	1	$394,805	$-	$-	$-
ST45	Spring Valley SPS	Condition	$338,100	2	$-	$391,393	$-	$-
ST46	Cameron	Condition	$515,600	2	$-	$596,871	$-	$-
ST47	Breithaupt	Condition	$264,600	4	$-	$-	$-	$337,704
ST48	Mcleod	Condition	$253,100	2	$-	$292,995	$-	$-
ST49	Gateway Park	Condition	$1,535,100	1	$1,692,448	$-	$-	$-
ST50	Brembel	Condition	$323,400	4	$-	$-	$-	$412,749
ST51	Denlow	Condition	$316,100	4	$-	$-	$-	$403,433
ST52	Alpine	Condition	$387,500	3	$-	$-	$471,009	$-
ST53	Hollinger	Condition	$444,200	1	$489,731	$-	$-	$-
ST54	Hazel Glen	Condition	$326,600	2	$-	$378,080	$-	$-
ST55	Stoke	Condition	$466,200	4	$-	$-	$-	$595,002
ST56	Driftwood	Condition	$464,100	2	$-	$537,254	$-	$-
ST57	Fisher Hallman	Condition	$571,200	3	$-	$-	$694,297	$-
ST58	West Heights	Condition	$686,700	3	$-	$-	$834,688	$-
ST59	Overlea	Condition	$410,600	2	$-	$475,321	$-	$-
ST60	Stoneybrook	Condition	$463,100	2	$-	$536,096	$-	$-
ST61	Barberry	Condition	$432,600	4	$-	$-	$-	$552,119
ST62	Sandsprings	Condition	$528,200	4	$-	$-	$-	$674,132
ST63	Cherry Hill	Condition	$243,600	3	$-	$-	$296,097	$-
ST64	Coach Hill	Condition	$637,400	3	$-	$-	$774,764	$-
ST65	Coach Hill	Condition	$389,600	3	$-	$-	$473,561	$-

Short Term Project ID	Project Name	Project Type	Recommended Budgetary Estimate	Priority	2024	2025	2026	2027
ST66	Selkirk	Condition	$414,800	2	$-	$480,183	$-	$-
ST67	Highland	Condition	$379,100	2	$-	$438,856	$-	$-
ST68	Paulander	Condition	$579,600	1	$639,009	$-	$-	$-
ST69	Weichel	Condition	$466,200	3	$-	$-	$566,669	$-
ST70	Belmont	Condition	$480,900	3	$-	$-	$584,537	$-
ST71	Union	Condition	$335,000	3	$-	$-	$407,195	$-
ST72	Union	Condition	$734,000	1	$809,235	$-	$-	$-
ST73	Guelph	Condition	$429,500	3	$-	$-	$522,060	$-
ST74	Wheatfield	Condition	$237,300	4	$-	$-	$-	$302,862
ST75	Manitou	Condition	$1,046,900	2	$-	$1,211,918	$-	$-
ST76	Upper Canada	Condition	$425,300	3	$-	$-	$516,955	$-
ST77	Old Mill	Condition	$510,300	1	$562,606	$-	$-	$-
ST78	Old Mill	Condition	$363,300	4	$-	$-	$-	$463,673
ST79	Arrowhead	Condition	$533,400	1	$588,074	$-	$-	$-
ST80	Green Valley	Condition	$421,100	3	$-	$-	$511,850	$-
ST81	Lower Canada	Condition	$189,000	2	$-	$218,791	$-	$-
ST82	Dumfries	Condition	$503,000	4	$-	$-	$-	$641,970
ST83	Heritage	Condition	$602,700	1	$664,477	$-	$-	$-
ST84	Heritage	Condition	$458,900	2	$-	$531,234	$-	$-
ST85	Nipigon	Condition	$604,800	1	$666,792	$-	$-	$-
ST86	Burbank	Condition	$309,800	4	$-	$-	$-	$395,392
ST87	King	Condition	$553,400	2	$-	$640,630	$-	$-
ST88	Wyandotte	Condition	$524,000	3	$-	$-	$636,925	$-
ST89	Morrison	Condition	$214,200	1	$236,156	$-	$-	$-

Short Term Project ID	Project Name	Project Type	Recommended Budgetary Estimate	Priority	2024	2025	2026	2027
ST90	Morrison	Condition	$734,000	1	$809,235	$-	$-	$-
ST91	Burgetz	Condition	$360,200	3	$-	$-	$437,825	$-
ST92	Broadview	Condition	$369,600	2	$-	$427,858	$-	$-
ST93	Siebert	Condition	$297,200	3	$-	$-	$361,248	$-
ST94	Greenfield	Condition	$473,600	2	$-	$548,251	$-	$-
ST95	Broadmoor	Condition	$357,000	4	$-	$-	$-	$455,633
ST96	Hillmount	Condition	$237,300	3	$-	$-	$288,440	$-
ST97	Carrol	Condition	$319,200	3	$-	$-	$387,990	$-
ST98	Traynor	Condition	$419,000	2	$-	$485,045	$-	$-
Sub-Total Short-Term Projects			**$48,547,200**		**$14,678,853**	**$13,131,983**	**$15,463,550**	**$14,252,365**

Notes:
1- Budget adjusted from Condition Assessment Reports per City direction

Table 5-2: Medium Term Projects (2028 – 2031) Prioritization & Annual Costing

Medium Term Project ID	Project Name	Project Type	Recommended Budgetary Estimate	Priority	2028	2029	2030	2031
MT1	Dalewood	Capacity	$1,463,000	1	$1,960,560			
MT2	Upstream of King St SPS	Capacity	$811,000	1	$1,086,818			
MT3	New Dundee PS	Capacity	$776,000	2		$1,091,910		
MT4	Robert Ferrie	Capacity	$805,000	3			$1,189,352	
MT5	All Pumping Stations	Condition	$1,193,000	-	$399,522	$419,498	$440,473	$462,497
Sub-Total Medium-Term Projects			**$5,048,000**		**$3,446,899**	**$1,511,408**	**$1,629,825**	**$462,497**

Table 5-3: Data Acquisition & Management Programs Annual Costing

Data Acquisition Project ID	Project Name	Project Type	Recommended Budgetary Estimate	2024	2025	2026	2027
DA 1[1]	Trunk Sewer Condition Assessment	Data Acquisition	$540,270	$148,912	$156,358	$164,175	$172,384
DA 2	Forcemain Condition Assessment	Data Acquisition	$776,000	$213,885	$224,579	$235,808	$247,599
DA 3	I/I Reduction and Mitigation Program	Data Acquisition	$3,174,358	$782,775	$944,159	$998,402	$1,055,958
DA 4	Rainfall and Flow Monitoring Program	Data Acquisition	$1,849,181	$275,625	$615,278	$647,920	$682,347
DA 5	Sanitary Hydraulic Model Updates & Maintenance Program	Data Acquisition	$804,000	$469,665	$145,861	$153,154	$160,811
DA 6	Hydrogen Sulfide Monitoring Program	Data Acquisition	$316,000	$207,270	$74,088	$77,792	-

Data Acquisition Project ID	Project Name	Project Type	Recommended Budgetary Estimate	2024	2025	2026	2027
Total Data Acquisition and Management Programs			**$7,459,810**	**$2,098,132**	**$2,160,322**	**$2,277,252**	**$2,319,098**

Note:
1 - Does not include current budget for hot spot flushing

Table 5-4: Summary of Annual Costing for 2024 - 2031

	2024	2025	2026	2027	2028	2029	2030	2031
Capital Projects	$14,678,853	$13,131,983	$15,463,550	$14,252,365	$3,446,899	$1,511,408	$1,629,825	$462,497
Data Acquisition	$2,098,132	$2,160,322	$2,277,252	$2,319,098	-	-	-	-
Total	**$16,776,985**	**$15,292,305**	**$17,740,802**	**$16,571,463**	**$3,446,899**	**$1,511,408**	**$1,629,825**	**$462,497**

In addition of the annual costing from 2024 to 2031, there is long-term projects (2032 – 2051) with the recommended budgetary estimate presented in **Table 5-5**.

Table 5-5: Long-Term Projects (2032 - 2051)

Long Term Project ID	Project Name	Project Type	Recommended Budgetary Estimate
LT1	Manchester	Capacity	$1,126,149
LT2	All Pumping Stations	Condition	$596,259
		Sub-Total Long-Term Projects	**$1,722,408**

Note that the condition-based project the repair required is uncertain as the work is solely based on a CCTV score, as mentioned in **Section 4.3.3**. Therefore, to implement the condition-based projects, further review of existing CCTV videos should be undertaken and/or additional CCTV investigation completed to ascertain the precise nature of the required repair.

Moreover, with existing aging and outdated CCTV data, there is the expectation that increased CCTV work will populate projects in the medium-term category, thus it is recommended that the City budget accordingly for projects which have yet to be identified.

6.0 CRITICAL FAILURE ANALYSIS

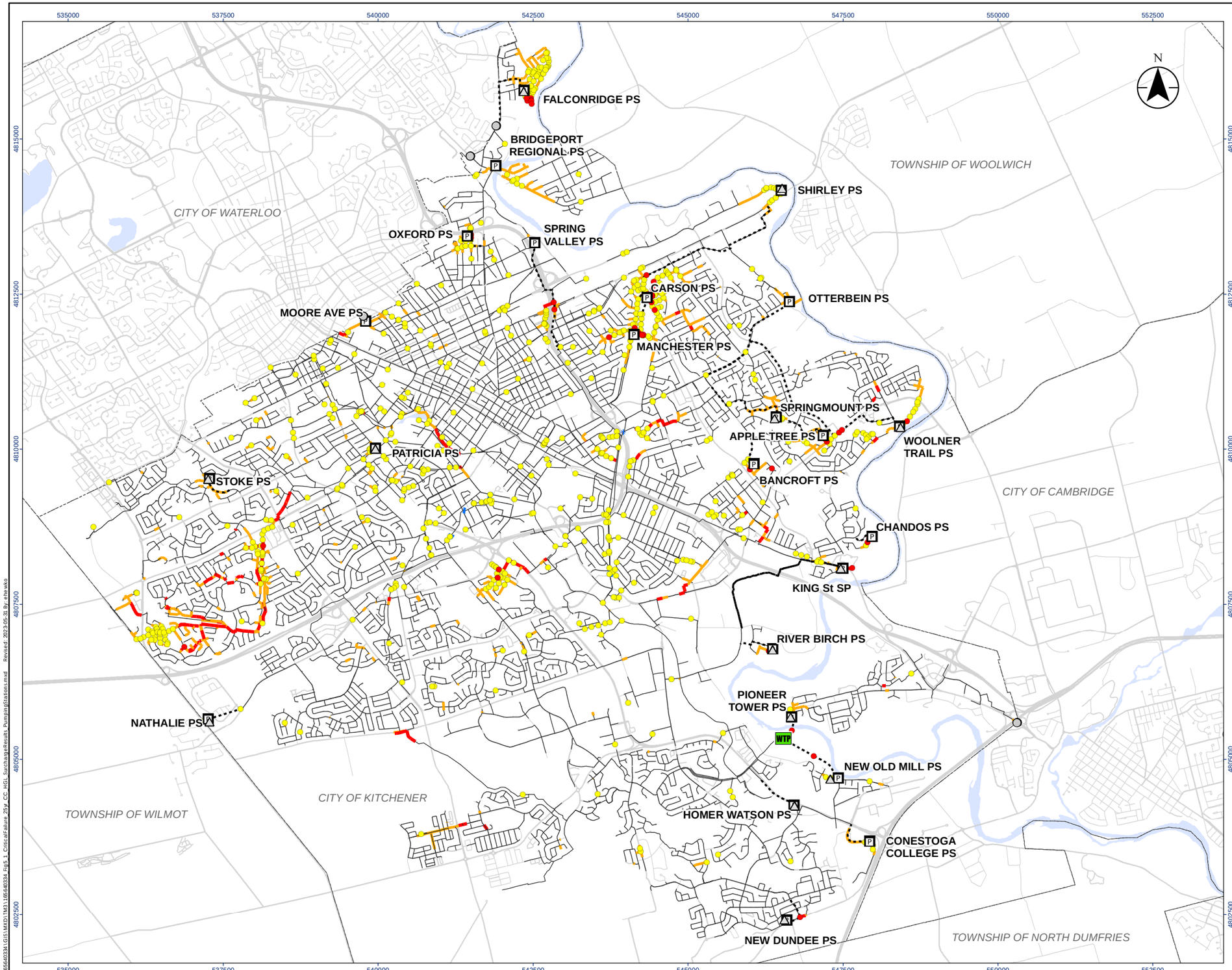
Failure of critical trunks and facilities within the system can result in severe flooding concerns. A critical failure analysis is therefore used to assess upstream system response and the current available redundancy in the existing infrastructure during the 25-year + CC event, as derived based on **Section 3.2.** For this analysis, sediment is applied to represent pipe failures in the 2051 model scenario at four (4) locations, which are selected based on criticality within the system (i.e., significant drainage areas) and poor condition as per the CCTV scores provided by the City. Refer to **Table 6-1** for a list of the proposed critical failure analysis locations and rationale. Refer to **Figure 6-1, Figure 6-2, Figure 6-3, Figure 6-4**, and **Figure 6-5** illustrating the selected pumping facilities and trunk sewer locations for the critical failure analysis and corresponding 2051 conditions system response in the 25-year + CC event, respectively. As some of these trunks are in series, the critical failure assessments are broken down into separate model scenarios to limit the impact of the upstream failures.

For facility criticality analyses, all pumping stations are tested with complete, simultaneous pump failure to determine upstream system response. This is performed by applying a flow limit of 0 L/s to the idealized pump stations in the model.

Table 6-1: Selected Critical Trunk Sewers for Failure Analysis

Trunk Sewer Name	Suggested Link ID for Failure Analysis	Rationale
All Pumping Stations	-	Critical facilities within the system
Ottawa Direct	301192.1	Known sewer collapse; CCTV score of 5
Montgomery Direct	300583.1	Concern for sewer collapse noted by City; significant drainage area
Upper Schneider Direct	300579.1	Significant drainage area
Strasburg Direct	303094.1	Significant drainage area

Based on the presented results, flooding conditions are observed. It is therefore recommended to conduct CCTV data acquisition every 5 years (instead of 10) for the Ottawa, Montgomery, Upper Schneider, and Strasburg trunks. It is not currently recommended to provide redundancy at these locations as current conditions are not well known in these areas, or are soon to be replaced due to deteriorating condition (e.g., Ottawa St). Through the recommended data acquisition programs and frequent Master Plan updates outlined in **Section 4.4**, the need for implementation of future redundancy can be assessed regularly.



Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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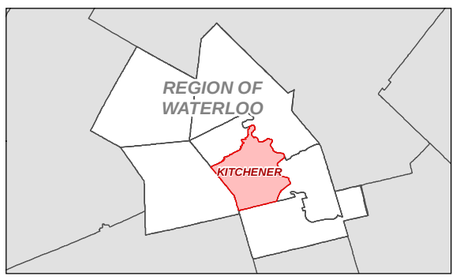


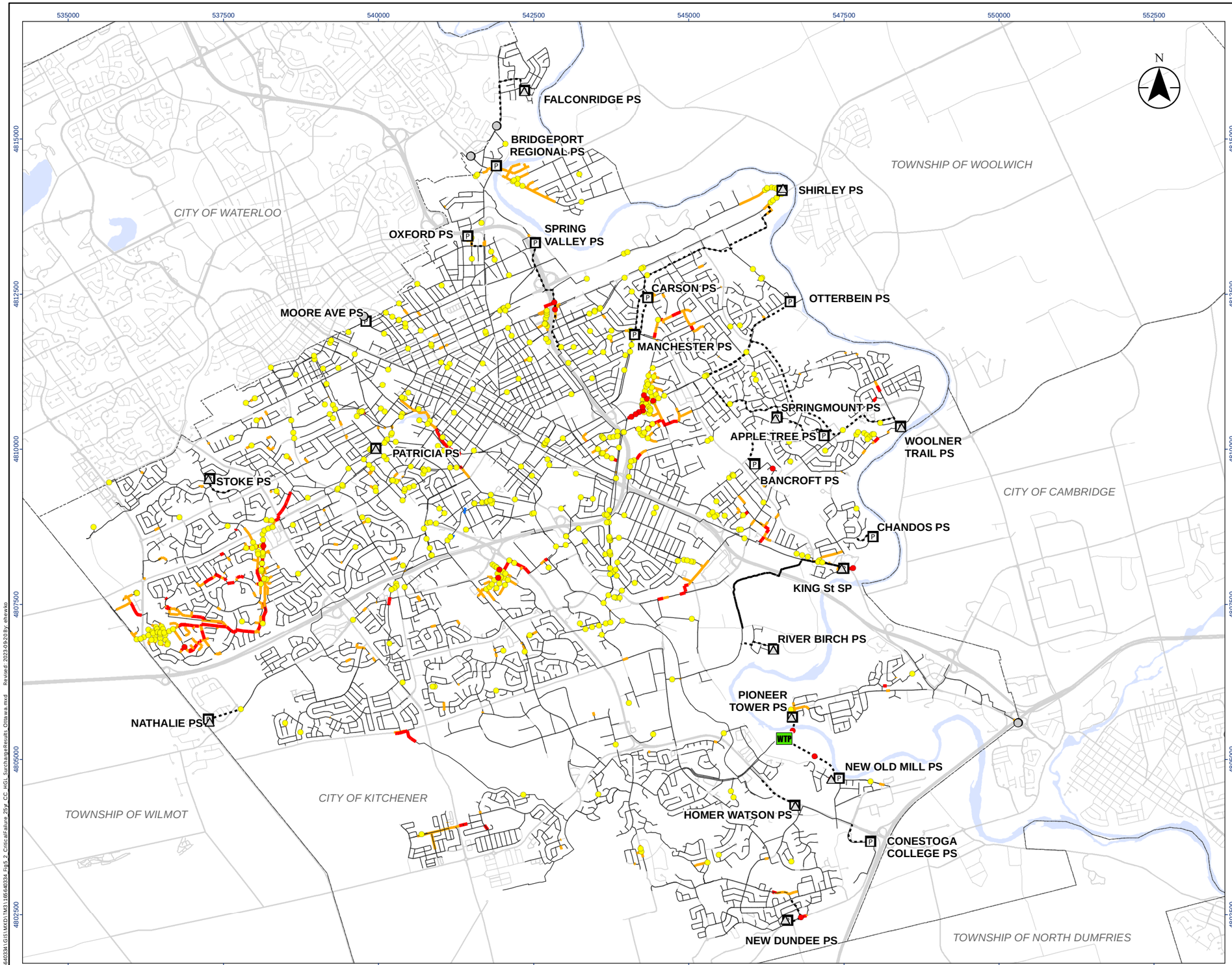
Project Location
City of Kitchener

165640334 REVA
Prepared by EH on 2023-05-31

Client/Project
CITY OF KITCHENER
INTEGRATED SANITARY MASTER PLAN

Figure No.
6.1

Title
Critical Failure Analysis - 25-Year Climate Change HGL & Surcharge Results (Pumping Stations)



Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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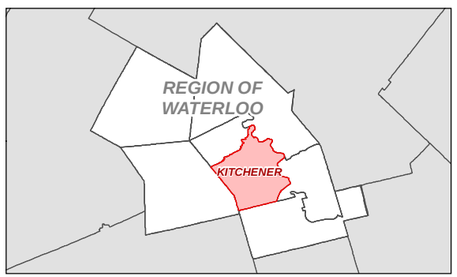

Project Location
City of Kitchener

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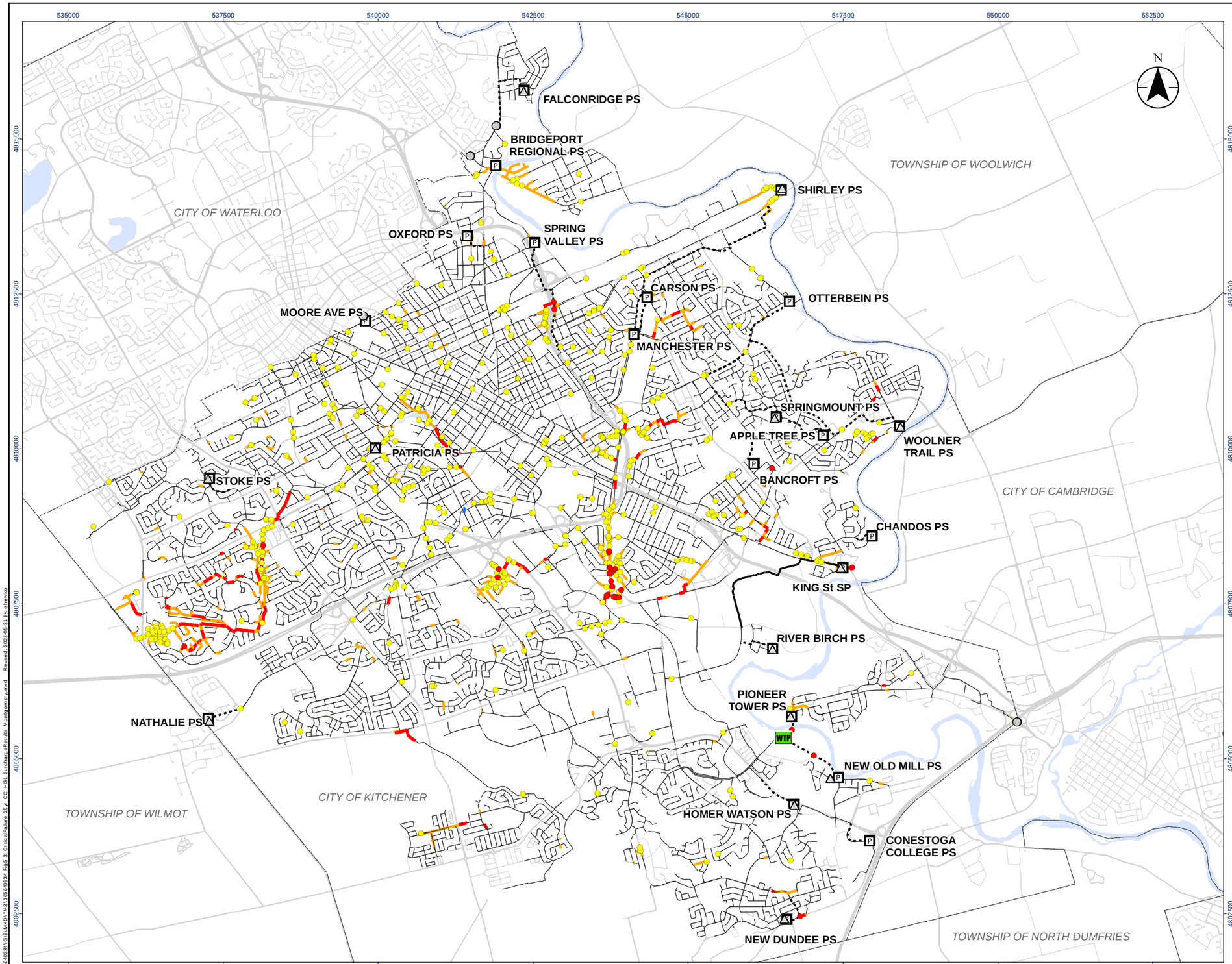
INTEGRATED SANITARY MASTER PLAN

Figure No.
6.2

Title
Critical Failure Analysis - 25-Year Climate Change HGL & Surcharge Results (Ottawa Direct)

U:\165640334\GIS\MXD\TM3\165640334_Fig5_2_CriticalFailure_25yr_CC_HGL_SurchargeResults_Ottawa.mxd Revised: 2023-09-20 By: ehewko



Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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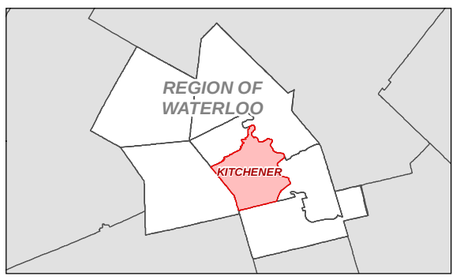

Project Location
City of Kitchener

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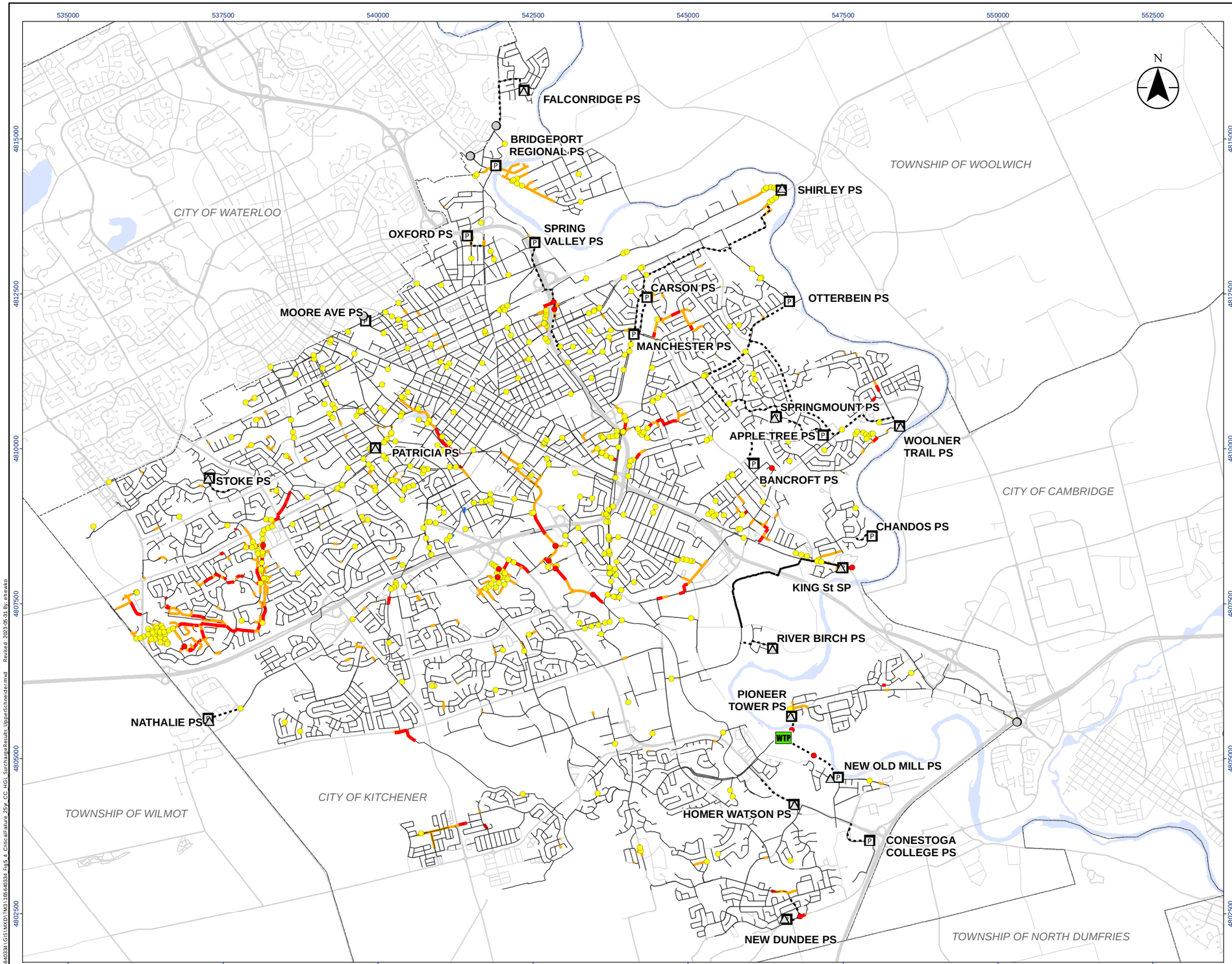
Figure No.
6.3

Title
Critical Failure Analysis - 25-Year Climate Change HGL & Surcharge Results (Montgomery Direct)



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Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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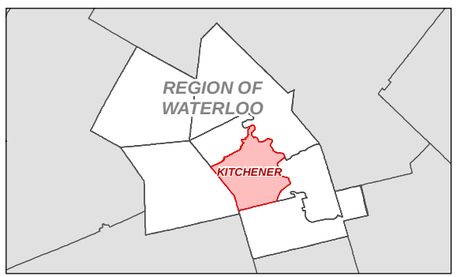

Project Location
City of Kitchener

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Prepared by EH on 2023-05-31

Client/Project
CITY OF KITCHENER
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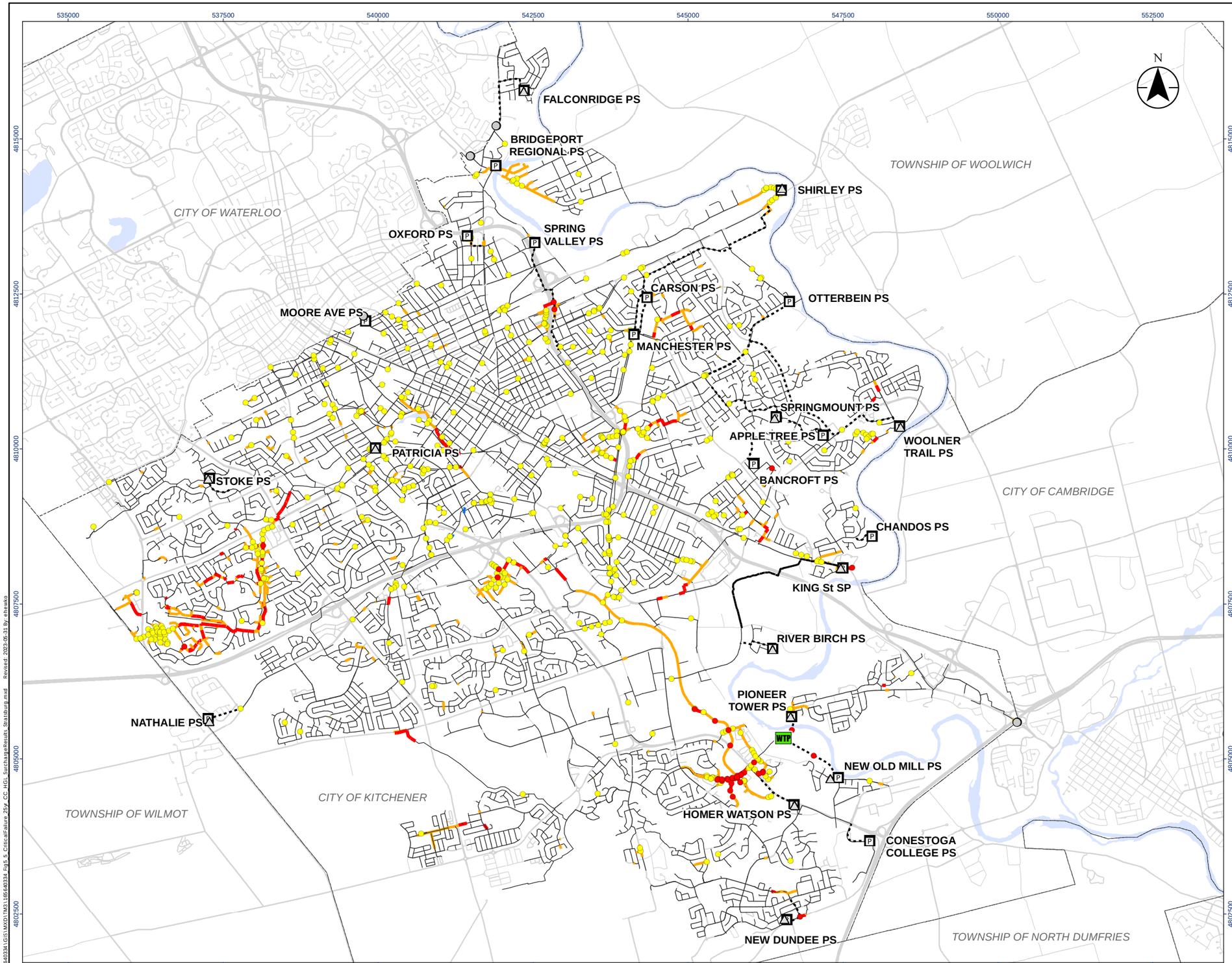
Figure No.
6.4

Title
Critical Failure Analysis - 25-Year Climate Change HGL & Surcharge Results (Upper Schneider Direct)



Stantec

Legend

- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Forcemain
- Siphon

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck Conditions (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 1 2 km

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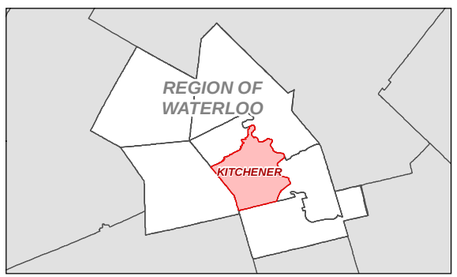

Project Location
City of Kitchener

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Client/Project
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Figure No.
6.5

Title
Critical Failure Analysis - 25-Year Climate Change HGL & Surcharge Results (Stratsburg Direct)

7.0 CONCLUSIONS

This technical memorandum (TM3) outlines the existing and future conditions capacity-based assessment results and existing sanitary sewer system data collection and management programs, along with alternative solutions to the observed vulnerabilities. It also discusses climate change impacts and critical failure considerations. Key components of this TM are described below:

- An overview of previous TMs and work completed as part of Task 1 and 2 of the Kitchener ISAN-MP;
- A review of existing conditions model set-up, WWTP flow validation, and capacity-based system performance (**Section 2.1**);
- Condition-based system assessment and results (**Section 2.2**);
- Ongoing sanitary sewer system data collection and management programs conducted by the City, such as CCTV programs, sewer flushing, I/I estimation, rainfall and flow monitoring, and model updates and maintenance (**Section 2.3**);
- Future conditions system assessment and results for both the 2031 and 2051 growth horizons (**Section 3.0**);
- Alternative solution review and recommendations following the Municipal Class EA process, including costing:
    - Alternative 1 – Do nothing (**Section 4.1**);
    - Alternative 2 – Shaping community growth (**Section 4.2**);
    - Alternative 3 – Infrastructure updates, including climate change sensitivity (**Section 4.3**); and,
    - Alternative 4 – Data acquisition, flow monitoring and I/I Mitigation programs (**Section 4.4**);
- Implementation sequencing of the proposed infrastructure updates and programs (**Section 5.0**)
- Critical failure analysis results (**Section 5.0**).

In general, the following main considerations result from the foregoing TM:

- The model calibration results in a good overall fit at the downstream WWTP, further encouraging the use of the calibrated model for existing and future conditions system assessments and solutions development;
- In existing conditions,
    - A total of six (6) capacity-based sewer problem areas are identified based on existing conditions modelling results, including:
        - A few sewer segments located just upstream of the King St SPS;
        - The Dalewood Dr area;
        - The area upstream of the Spring Valley SPS triggered by pumping station capacity constraints;

        - The Homer Watson area;
        - A few segments of the Sandrock Trunk sewer; and,
        - The area upstream of the Shirley SPS triggered by pumping station capacity constraints.

    - Additionally, four (4) pumping stations do not meet criteria under existing conditions, in that the 10-year flows draining to the Bridgeport SPS, Pioneer Tower SPS, Shirley SPS and Spring Valley SPS exceed their firm and rated capacities. As discussed above, only the Spring Valley SPS and Shirley SPS result in HGL and sewer surcharge concerns upstream of the facility. The 10-year incoming flows to Bridgeport SPS and Spring Valley SPS also exceed their current ECA approved rates. Note that Pioneer Tower SPS has been upgraded since the system assessment, and that the Bridgeport SPS and Spring Valley SPS are owned by the Region of Waterloo and not the City of Kitchener;

    - A total of 78 condition-based problem areas (108 pipes totaling 7.1 km) are identified based on the provided CCTV data (see **Table 2-5** for relevant pipe asset IDs and descriptions); and,
    - Ongoing programs conducted by the City provide valuable information on asset conditions, potential I/I contributions, system flows and operation, and system improvement opportunities, and should be continued and potentially enhanced to improve system understanding and better define upcoming projects.

- In future conditions (2031 and 2051 growth scenarios),

    - An additional two (2) capacity-based sewer problem areas are identified, including:
        - A few sewer segments located downstream of the New Dundee SPS (triggered in 2031); and,
        - Sewers downstream of the Manchester SPS (triggered in 2051).

    - Additionally, four (4) pumping stations do not meet criteria under 2031 conditions, in that the 10-year flows draining to the Bridgeport SPS, New Dundee SPS, Pioneer Tower SPS, and Shirley SPS in the 2031 future conditions scenario exceed their firm and rated capacities. The 10-year incoming flow to Bridgeport SPS, New Dundee SPS, and Spring Valley SPS also exceed their current ECA approved rates. In 2051 conditions, the same four (4) pumping stations do not meet criteria in that the 10-year flows draining to the Bridgeport SPS, New Dundee SPS, Pioneer Tower SPS, and Shirley SPS in the 2051 future conditions scenario exceed their firm and rated capacities. The 10-year incoming flow to Apple Tree SPS, Bridgeport SPS, New Dundee SPS, and Spring Valley SPS also exceed their current ECA approved rates. Note that Pioneer Tower SPS has been upgraded since the system assessment, thus was removed from the project list.

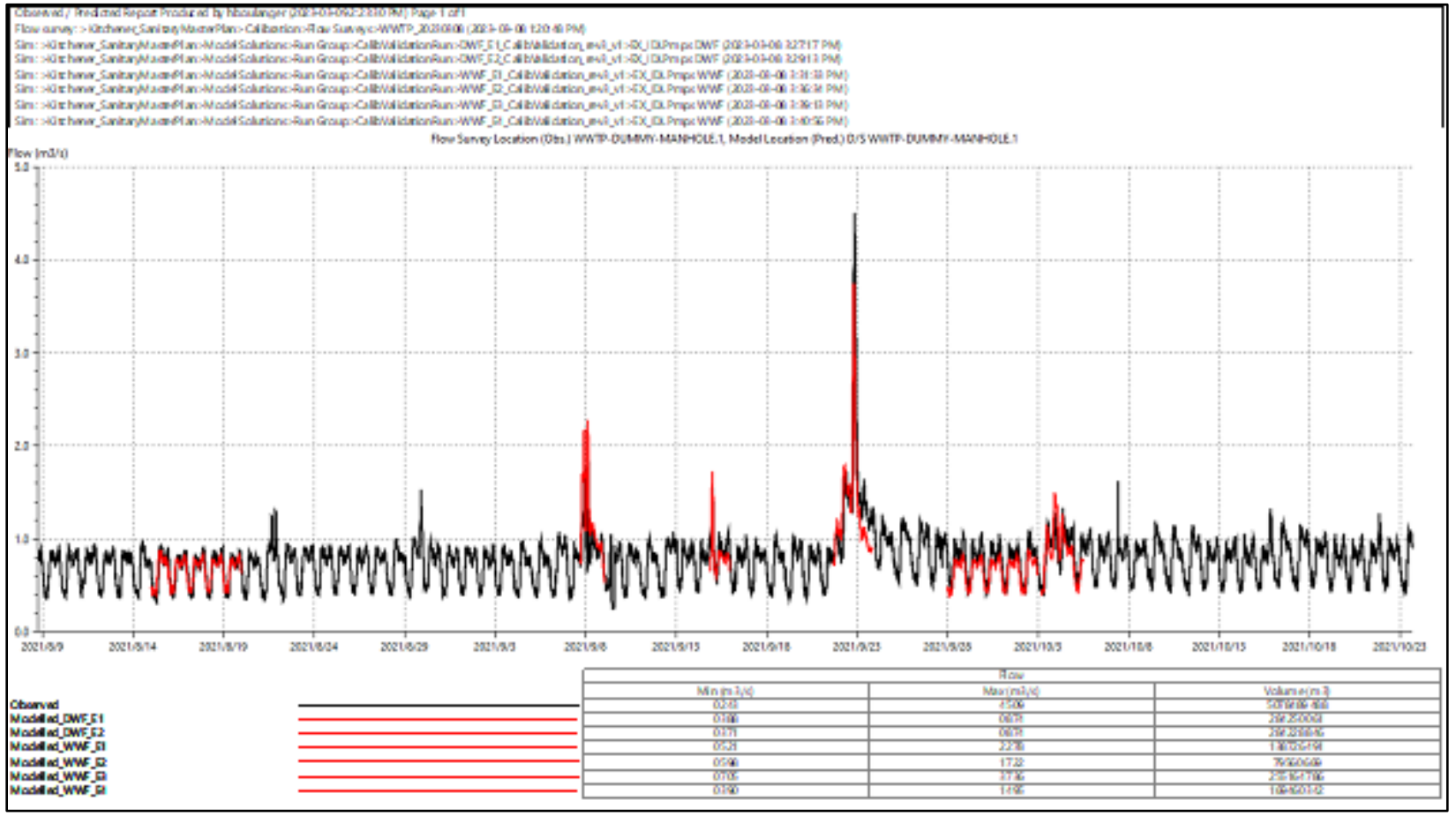
- Alternative solutions are assessed and recommended with the intention of improving the City's sanitary sewer infrastructure and data collection and management programs. The following summarizes the outcome of the four (4) alternative assessments, which follow the EA process:

    - **Alternative 1 – Do Nothing**: Screened out as it does not align with the City's strategy for the Integrated Sanitary MP;
    - **Alternative 2 – Shaping Community Growth**: Based on existing conditions, 2031 and 2051 system assessment results, there are no significant concerns with trunk sewer capacity within the sanitary system, other than the Sandrock trunk, which can be resolved with relatively minor upgrade requirements;
    - **Alternative 3 – Infrastructure Updates**: Based on 2051 growth scenario results, a total of eight (8) capacity-based projects are recommended to resolve HGL and surcharge issues, as well as SPS capacity constraints, as presented in **Table 4-1**. The total recommended budgetary estimation for these solutions is $16,301,000, which includes contingency (30%) and engineering (20% or more) allowances in 2023 dollars. Some of these solutions and other locations within the system are sensitive to climate change and may result in additional upgrade costs in the future if I/I mitigation programs are not implemented. Additionally, based on provided CCTV score data, 76 condition-based projects are recommended, as presented in **Table 4-4**, totaling $36,972,600 in recommended budgetary estimates; and,
    - **Alternative 4 – Data Acquisition, Flow Monitoring, and I/I Mitigation Programs**:
        - A robust sanitary trunk sewer and forcemain condition data acquisition program is recommended that involves more frequent cycling of data collection. Trunk sewers and forcemains have been evaluated regarding relevance of the available condition data and age of sewer, which is used to categorize the sewers into near-, medium-, and long-term data acquisition projects..
        - An I/I reduction and mitigation program is also recommended, paired with ongoing rainfall and flow monitoring programs and continual sanitary hydraulic model updates and maintenance. These programs will help the City to stay on top of new capacity concerns, leaky areas, areas where unwanted connections exist, etc., that can be resolved to reduce inflows into the system.
        - A rainfall and flow monitoring program is also recommended to strategically retrieve and organize data for future programming and capital needs.
        - Continued development, updates and maintenance of the sanitary modelling tool is recommended for a fit-for-purpose application for City infrastructure planning and assessment.
        - A hydrogen sulfide monitoring program is recommended to identify presence and location of elevated levels within the existing sanitary system to inform if action is needed to implement control strategies.

- The implementation of the proposed capacity-based and condition-based projects, as well as the programmatic approaches were prioritized based on criticality for City consideration, including budgetary spend from 2024 to 2031.
- Finally, the critical failure analysis identified potential vulnerabilities in the system due to limited redundancy. It is recommended to conduct CCTV data acquisition along every 5 years instead of 10 for Ottawa, Montgomery, Upper Schneider, and Strasburg trunks.

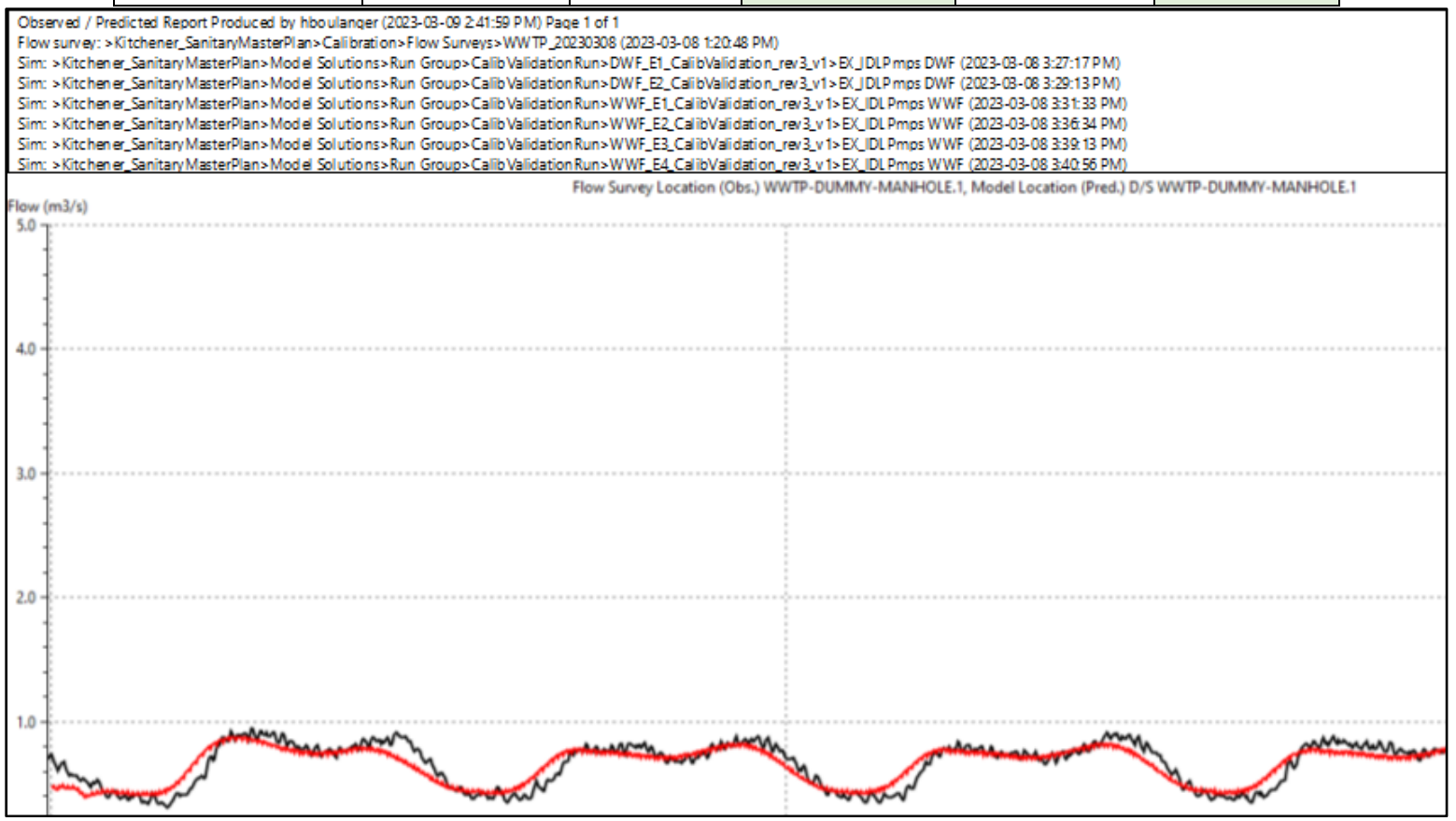
APPENDIX A – WWTP FLOW VALIDATION GRAPHS

Overview of the monitored data (black) and the calibrated periods/events (red)



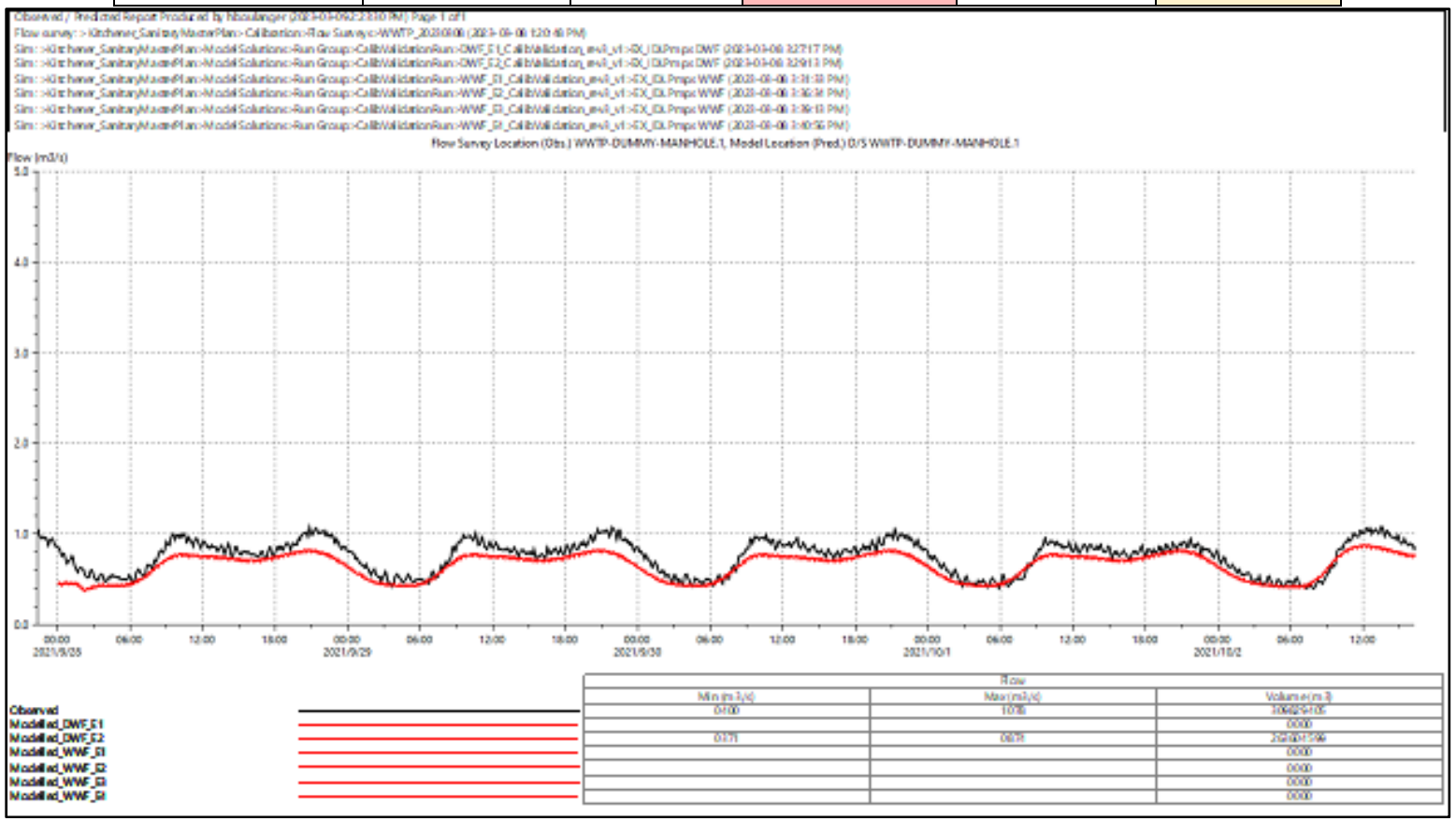
Dry Weather Flow – Period 1 (August 15th – 20th, 2021)

	Minimum Flow (CMS)	Peak Flow (CMS)	Peak Flow % Fit	Volume (m^3)	Volume % Fit
Observed	0.31	0.95	-7.50%	288,765	-1.70%
Modelled DWF P1	0.39	0.87		283,736	



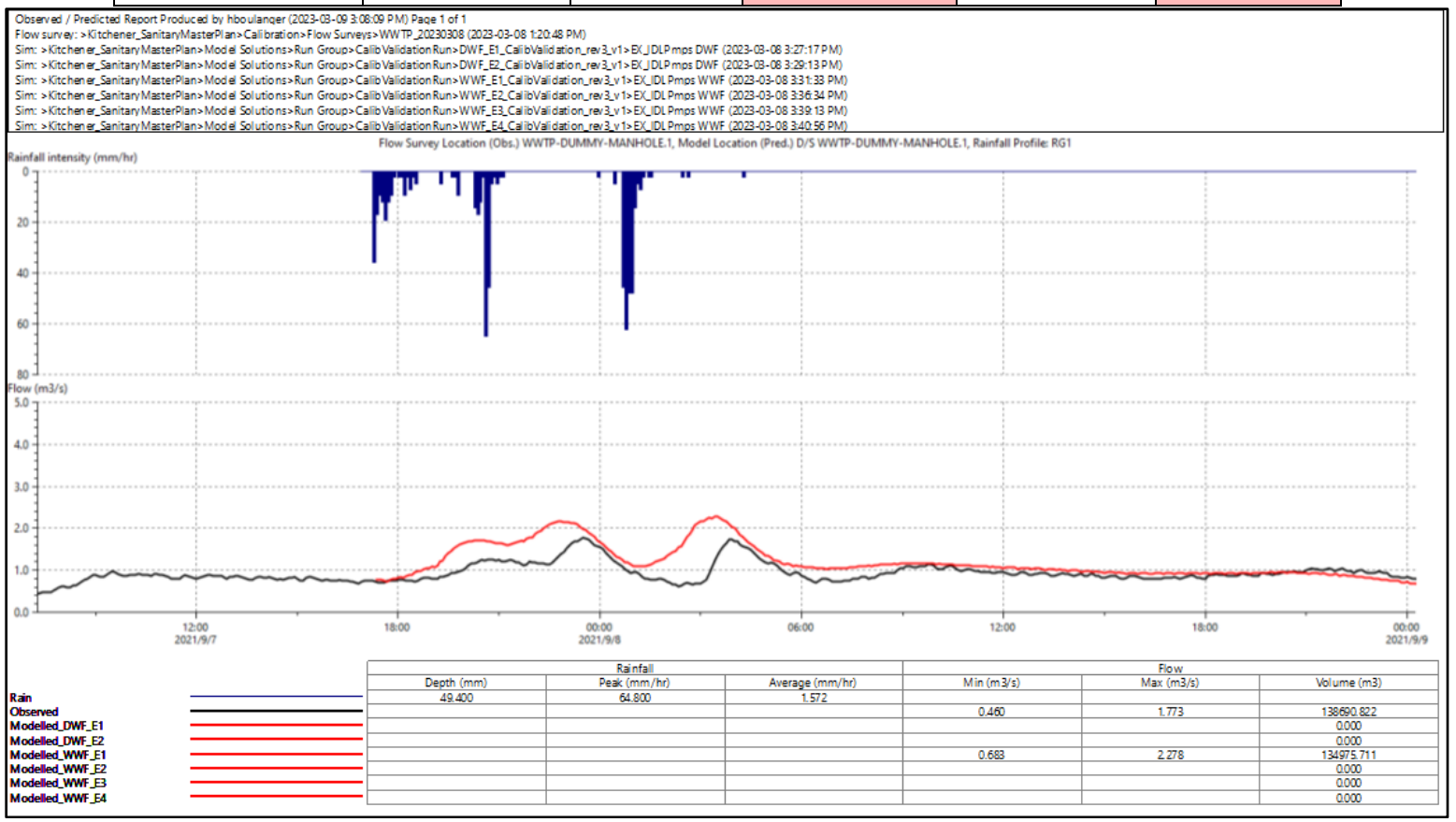
Dry Weather Flow – Period 2 (September 28th- October 3rd, 2021)

	Minimum Flow (CMS)	Peak Flow (CMS)	Peak Flow % Fit	Volume(m^3)	Volume % Fit
Observed	0.4	1.08	-18.90%	327,408	-13.30%
Modelled DWF P2	0.37	0.87		283,929	



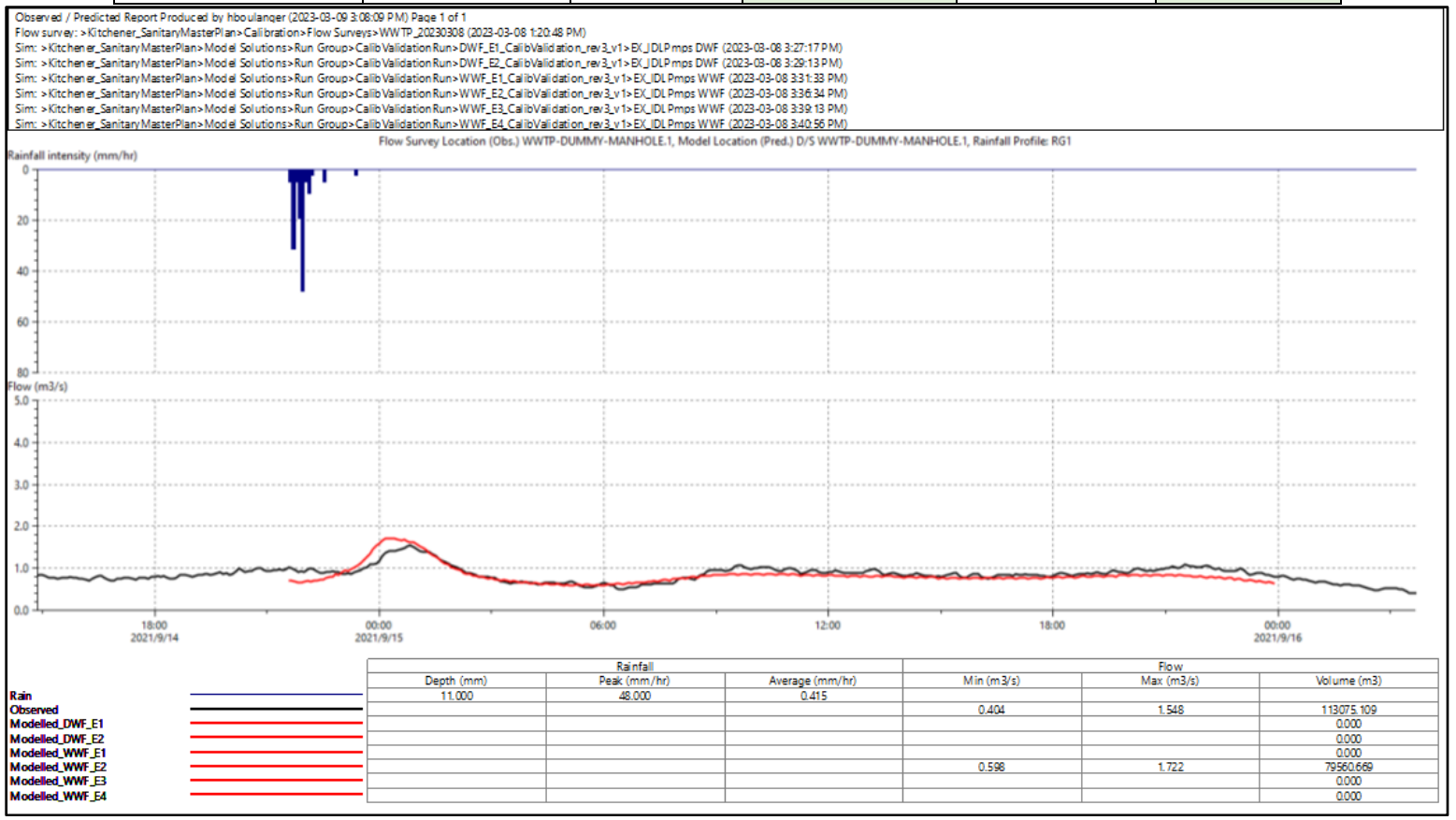
Wet Weather Flow – Event 1 (September 7th, 2021)

	Minimum Flow (CMS)	Peak Flow (CMS)	Peak Flow % Fit	Volume(m^3)	Volume % Fit
Observed	0.63	1.77	28.50%	107,657	23.30%
Modelled WWF E1	0.71	2.28		132,700	



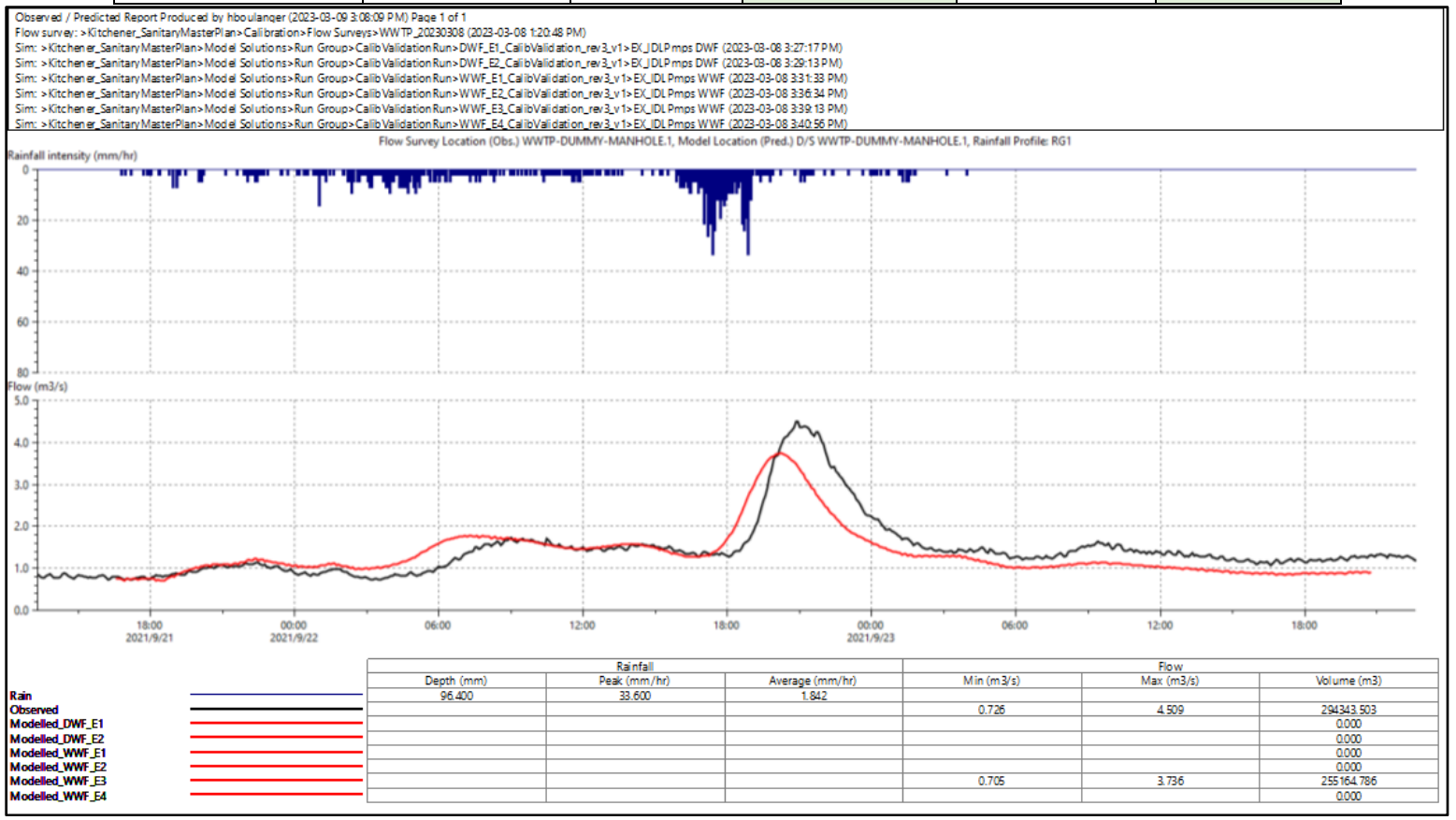
Wet Weather Flow – Event 2 (September 14th, 2021)

	Minimum Flow (CMS)	Peak Flow (CMS)	Peak Flow % Fit	Volume(m^3)	Volume % Fit
Observed	0.5	1.55	11.20%	84,069	-5.80%
Modelled WWF E2	0.6	1.72		79,188	



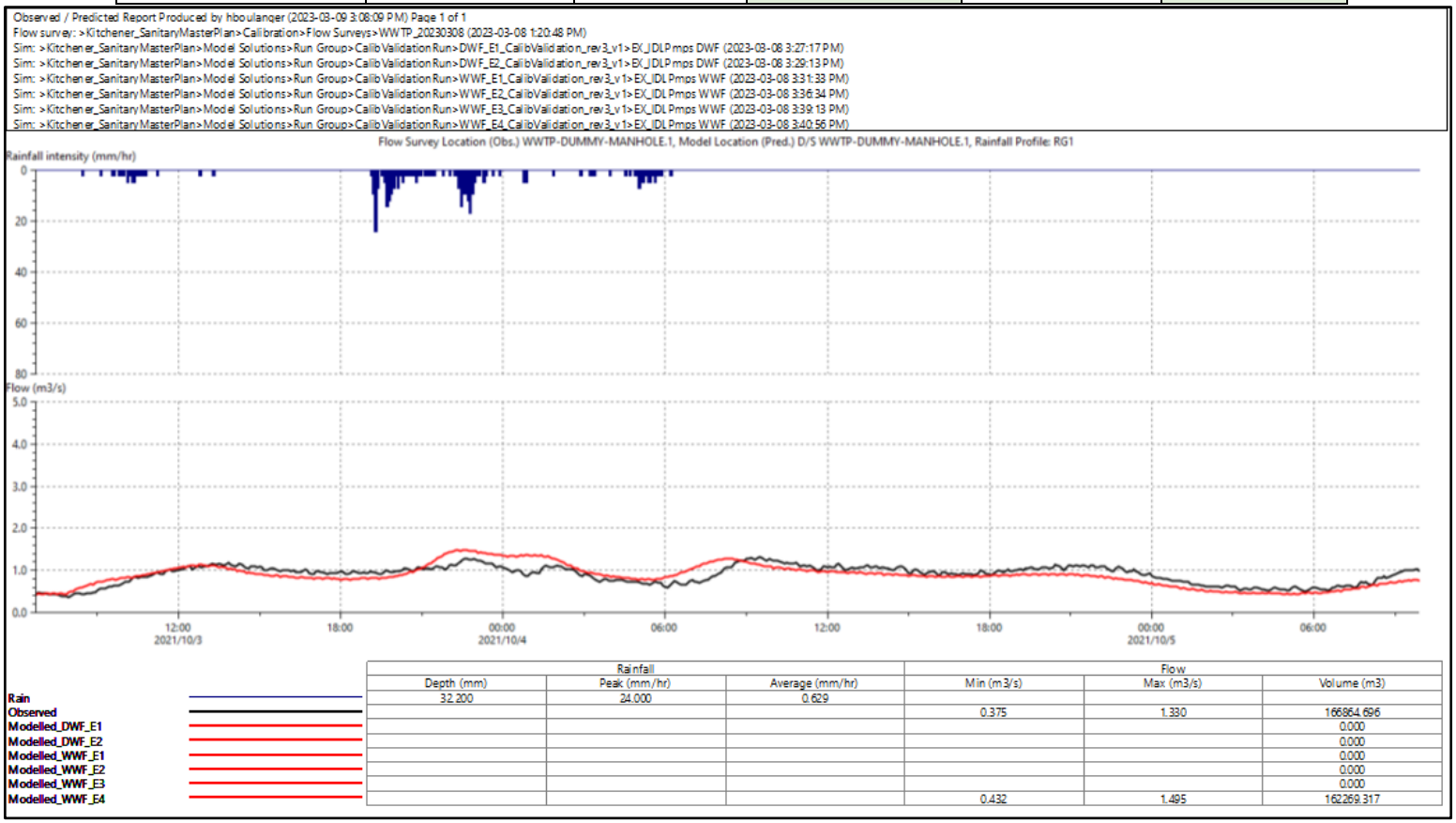
Wet Weather Flow – Event 3 (September 21st, 2021)

	Minimum Flow (CMS)	Peak Flow (CMS)	Peak Flow % Fit	Volume(m^3)	Volume % Fit
Observed	0.73	4.51	-17.10%	274,589	-7.60%
Modelled WWF E3	0.71	3.74		253,784	



Wet Weather Flow – Event 4 (October 3rd, 2021)

	Minimum Flow (CMS)	Peak Flow (CMS)	Peak Flow % Fit	Volume(m^3)	Volume % Fit
Observed	0.38	1.33	12.40%	173,786	-3.40%
Modelled WWF E4	0.41	1.5		167,825	



APPENDIX B – PROPOSED CAPACITY-BASED SOLUTION SUMMARIES

Appendix B
March 18, 2024

B.1 - SOLUTION DETAILS, INCLUDING CLOSE-UP PLAN VIEWS AND PROFILES OF EACH OF THE PROPOSED SOLUTIONS

535000 537500 540000 542500 545000 547500 550000 552500

4815000 4812500 4810000 4807500 4805000 4802500

N

FALCONRIDGE PS
BRIDGEPORT REGIONAL PS
CB-5
SHIRLEY PS
TOWNSHIP OF WOOLWICH
CITY OF WATERLOO
OXFORD PS
SPRING VALLEY PS
CARSON PS
OTTERBEIN PS
MOORE AVE PS
MANCHESTER PS
CB-8
SPRINGMOUNT PS
APPLE TREE PS
WOOLNER TRAIL PS
CB-2
PATRICIA PS
BANCROFT PS
STOKE PS
CB-4
CITY OF CAMBRIDGE
CB-3
CB-1
CHANDOS PS
KING St SP
RIVER BIRCH PS
PIONEER TOWER PS
NATHALIE PS
WTP
NEW OLD MILL PS
CITY OF KITCHENER
TOWNSHIP OF WILMOT
HOMER WATSON PS
CONESTOGA COLLEGE PS
CB-7
CB-6
NEW DUNDEE PS
TOWNSHIP OF NORTH DUMFRIES

535000 537500 540000 542500 545000 547500 550000 552500

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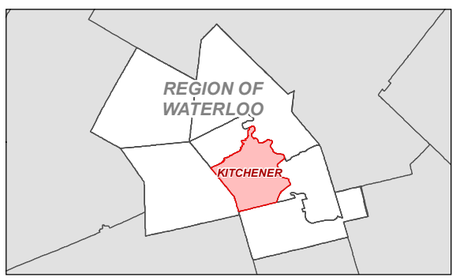
Stantec

Legend
- Sanitary Pumping Stations
- Outflow to Adjacent System
- PS Overflow
- WWTP
- Other Sewers
- Forcemain
- Capacity-Based Solution

0 1 2 km

1:62,500 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2021.
3. Contains information licensed under the Open Government Licence - The Corporation of the City of Kitchener, 2021.



Project Location
City of Kitchener

165640334 REVA
Prepared by EH on 2023-09-20

Client/Project
CITY OF KITCHENER
INTEGRATED SANITARY MASTER PLAN

Figure No.
4.1

DRAFT

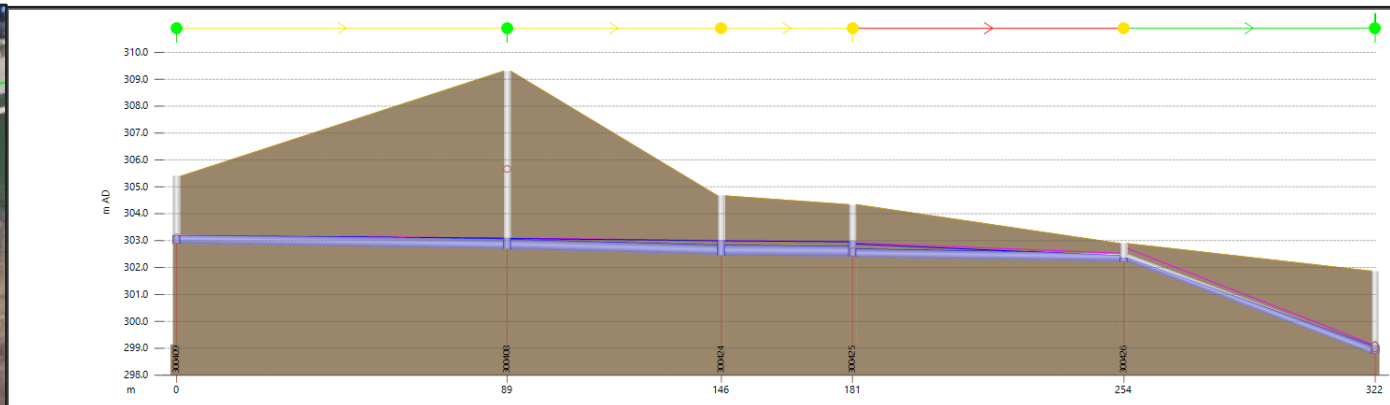
Title
Proposed Capacity-Based Solutions

D:\165640334\GIS\MXD\TM3\165640334_Fig4_1_ProjCapacityBasedSolution.mxd Revised: 2023-09-20 By: ehewko

Existing Conditions - 25yr Results - LOCAL

Montgomery – Freeport

CB-1: U/S of King St SPS



Link	300409.1	300408.1	300424.1	300425.1	300426.1
length (m)	88.7	57.5	35.2	72.9	67.5
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	350	350	375	300	300
us inv (m AD)	302.892	302.688	302.456	302.389	302.229
ds inv (m AD)	302.706	302.480	302.407	302.229	298.817
grad (m/m)	0.00210	0.00362	0.00139	0.00220	0.05056
pfc (m3/s)	0.067	0.088	0.065	0.045	0.217
ProblemAreaID	AC	AC	SA_1	AC	AC
SolutionTag	MONTGOMERY - FREEPORT	MONTGOMERY - FREEPORT		MONTGOMERY - FREEPORT	MONTGOMERY - FREEPORT
Trunk or Focus Area ID				GRWTH_DS	GRWTH_DS
Engineering Validation Check			SS	PAG	SS
Engineering Validation Fix			DSI_AB	PAG_FX	
surc	1.00	1.00	1.00	2.00	0.96
DS flow (m3/s)	0.04771	0.05476	0.05508	0.07246	0.07274

Node	300409	300408	300424	300425	300426	300427
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole
ground (m AD)	305.392	309.298	304.666	304.340	302.890	301.867
User text 1						
User text 2						
Trunk or Focus Area ID				GRWTH_DS	GRWTH_DS	TRNK:GRWTH_DS
Engineering Validation Check				IPHPD:GL_diff		
Engineering Validation Fix				GL_ELEV	GL_ELEV	
exprHGL	2.206087	6.208706	1.668838	1.384342	0.537217	2.763820

Note:

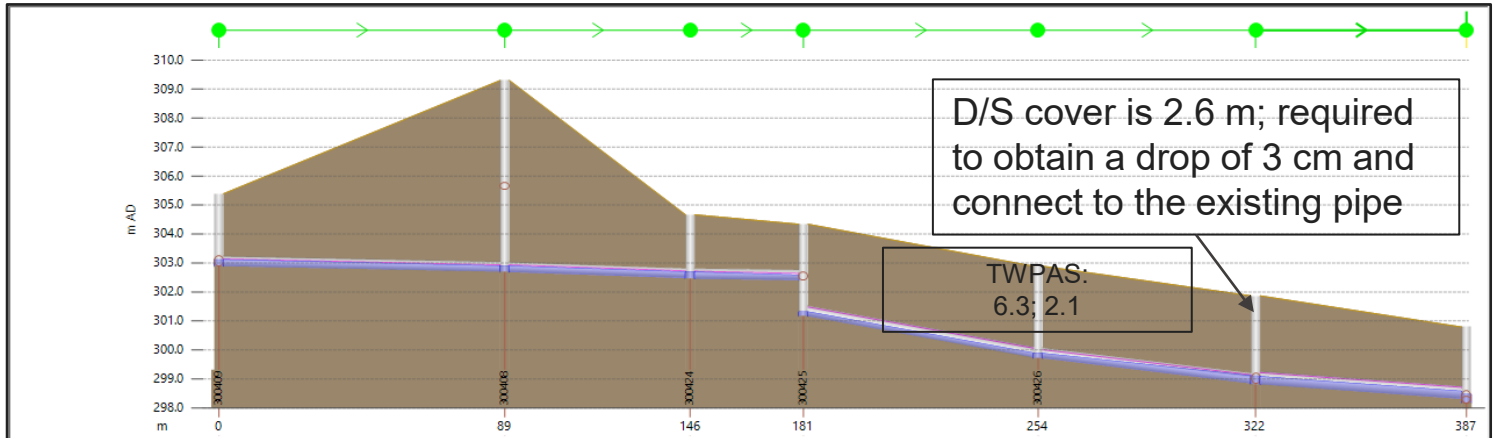
The conduits on King St are shallow, therefore the recommended freeboard is not obtained (≥1.8 m).

Recommendation:

Upgrade and reprofile pipes (i.e., adjust slopes).

Existing Conditions Solutions - 25yr Results - LOCAL

Montgomery – Freeport
SA-1: U/S of King St SPS



Link		300409.1		300408.1	300424.1	300425.1	300426.1	300427.1	
length (m)		88.7		57.5	35.2	72.9	67.5	65.5	
Shape ID		CIRC		CIRC	CIRC	CIRC	CIRC	CIRC	
width (mm)		350		350	375	375	375	450	
us inv (m AD)		302.892		302.688	302.456	301.165	299.715	298.817	
ds inv (m AD)		302.706		302.480	302.407	299.745	298.847	298.311	
grad (m/m)		0.00210		0.00362	0.00139	0.01949	0.01286	0.00773	
pfc (m3/s)		0.067		0.088	0.065	0.245	0.199	0.251	
ProblemAreaID		SA_1		SA_1	SA_1	SA_1	SA_1	SA_1	
SolutionTag						Upgrd:Drop	Upgrd:Drop		
Trunk or Focus Area ID						GRWTH_DS	GRWTH_DS	TRNK;GRWTH_DS	
Engineering Validation Check					SS	PAG	SS		
Engineering Validation Fix					DSI_AB	PAG_FX			
expr:US_Cover		2.1		6.3	1.8	2.8	2.8	2.6	
expr:DS_Cover		6.2		1.8	1.6	2.8	2.6	2.0	
surc		0.63		0.59	0.61	0.39	0.68	0.58	
DS flow (m3/s)		0.04794		0.05508	0.05540	0.07292	0.07319	0.15916	
Node	300409		300408		300424	300425	300426	300427	300428
Node type	Manhole		Manhole		Manhole	Manhole	Manhole	Manhole	Manhole
ground (m AD)	305.392		309.298		304.666	304.340	302.890	301.867	300.791
ProblemAreaID	SA_1		SA_1		SA_1	SA_1	SA_1	SA_1	SA_1
SolutionTag									
Trunk or Focus Area ID						GRWTH_DS	GRWTH_DS	TRNK;GRWTH_DS	-
Engineering Validation Check						IPI;IPD;GL_diff			IPI;DNP;GL_diff
Engineering Validation Fix						GL_ELEV	GL_ELEV		IPI_FX
expr:HGL	2.279817		6.404293		1.979568	3.028080	3.012375	2.763942	2.323532

Note:

2 x 400 mm forcemains of King St SPS crossing on the second solution pipe.

Solution within Surface Water Intake Protection Zone with vulnerability = 7.2.

Solution in model:

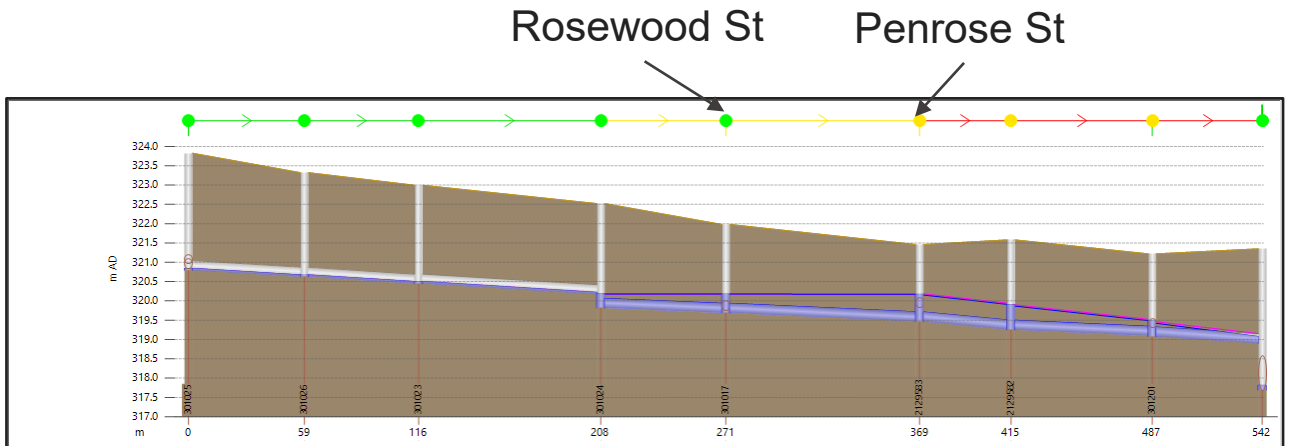
Replacement of 2 lengths of sewer - upsize from 300 mm diameter to 375 mm diameter sewer.

TWPAS: Total Wastewater Priority Assessment Score

Existing Conditions - 25yr Results - LOCAL

Montgomery – Manchester Direct

CB-2: Dalewood Dr



Link	301025.1	301026.1	301023.1	301024.1	301017.2	2129583.1	2129582.1	301201.1
length (m)	58.5	57.7	91.9	63.2	97.9	46.2	71.3	55.5
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	250	250	250	250	250	250	250
us inv (m AD)	320.796	320.622	320.445	319.814	319.687	319.462	319.249	319.072
ds inv (m AD)	320.622	320.445	320.171	319.687	319.467	319.256	319.092	318.902
grad (m/m)	0.00297	0.00307	0.00298	0.00201	0.00225	0.00446	0.00220	0.00306
pfc (m3/s)	0.032	0.033	0.032	0.027	0.028	0.040	0.028	0.033
ProblemAreaID	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2
SolutionTag								
Trunk or Focus Area ID					NEW	NEW	NEW	TRNK;NEW_DS
Engineering Validation Check					NewPipe	NewPipe	NewPipe	
Engineering Validation Fix				DSI_AB;USI_AB	CD_AB;DSI_AB;USI_AB	-	CD_AB;DSI_AB;USI_AB	-
surc	0.19	0.21	0.21	1.00	1.00	2.00	2.00	2.00
DS flow (m3/s)	0.00185	0.00227	0.00281	0.00330	0.00589	0.04244	0.04278	0.04502

Node	301025	301026	301023	301024	301017	2129583	2129582	301201	301204
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-
ground (m AD)	323.826	323.322	322.995	322.521	321.980	321.460	321.580	321.220	321.349
ProblemAreaID	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2
SolutionTag									
Trunk or Focus Area ID						NEW	NEW	TRNK	TRNK
Engineering Validation Check					IPD;BNFS	NewMH;IPD	NewMH	GL_diff	
Engineering Validation Fix					GE_AB	GE_AB	GE_AB	GE_AB	
exprHGL	2.985149	2.651559	2.496740	2.339878	1.801075	1.291879	1.674696	1.738707	-

Note:

City Comments:

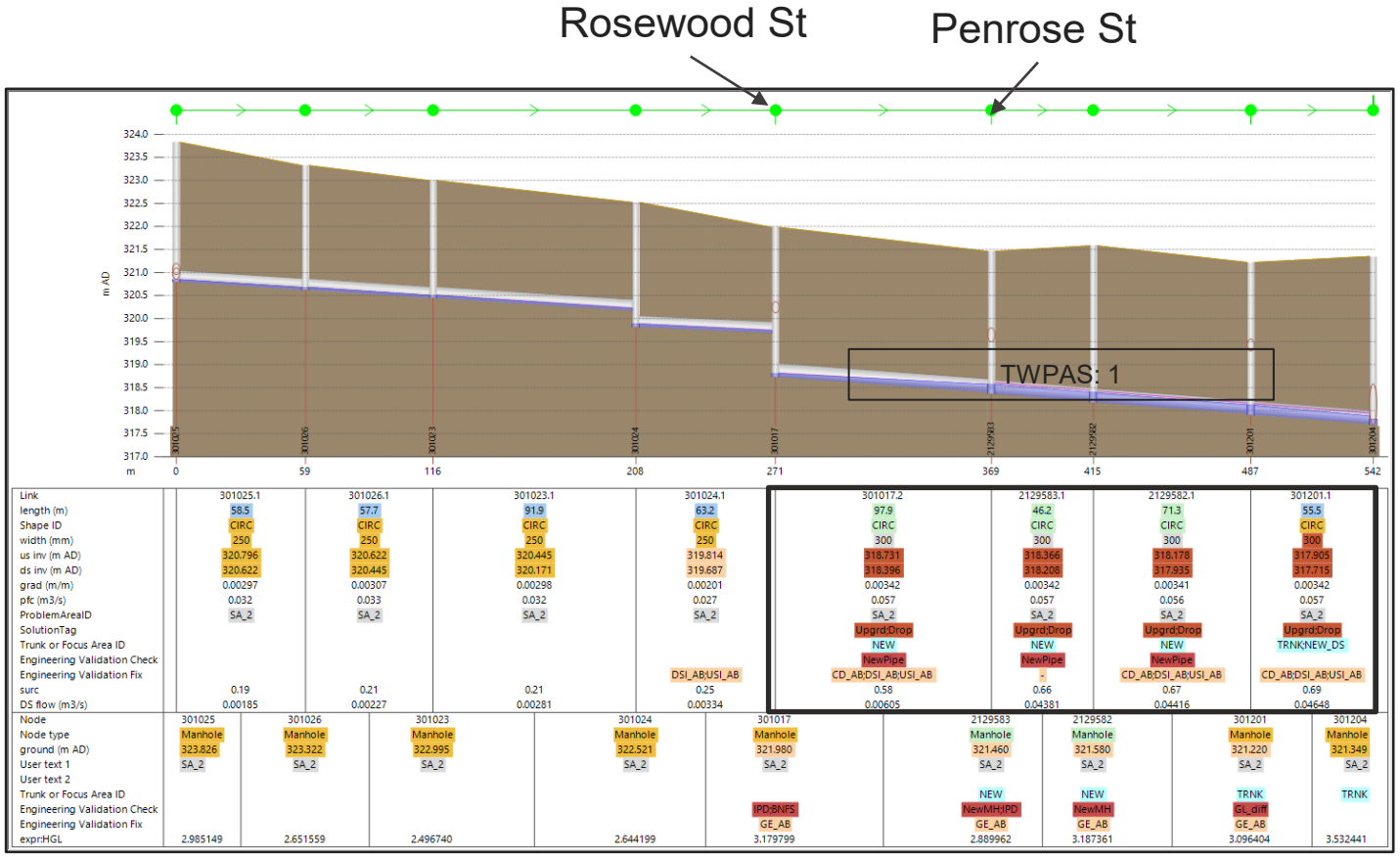
- "The Dalewood Dr sewer was flagged as being flat and causing backup. The worst part of the sewer was replaced but any improvements were limited to the downstream sewer elevations. To make improvements, the siphon downstream needs to be removed and the Montgomery sewer replaced and lowered back to the Schneider trunk sewer."
    - Based on what is originally in the model, this didn't appear to be the case (further downstream upgrades were not needed). However, new DWGs were provided that indicate that the pipe through the easement is actually a 250mm (not a 900mm), which generates a new HGL issue even with solutions provided.

Recommendation:

Provide conveyance upgrades.

Existing Conditions Solutions - 25yr Results - LOCAL

Montgomery – Manchester Direct
SA-2: Dalewood Dr – Alternative B



Link	301025.1	301026.1	301023.1	301024.1	301017.2	2129583.1	2129582.1	301201.1
length (m)	58.5	57.7	91.9	63.2	97.9	46.2	71.3	55.5
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	250	250	250	300	300	300	300
us inv (m AD)	320.796	320.622	320.445	319.814	318.731	318.366	318.178	317.905
ds inv (m AD)	320.622	320.445	320.171	319.687	318.396	318.208	317.935	317.715
grad (m/m)	0.00297	0.00307	0.00298	0.00201	0.00342	0.00342	0.00341	0.00342
pfc (m3/s)	0.032	0.033	0.032	0.027	0.057	0.057	0.056	0.057
ProblemAreaID	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2
SolutionTag					Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop
Trunk or Focus Area ID					NEW	NEW	NEW	TRNK;NEW_DS
Engineering Validation Check					NewPipe	NewPipe	NewPipe	
Engineering Validation Fix				DSI_AB;USI_AB	CD_AB;DSI_AB;USI_AB	-	CD_AB;DSI_AB;USI_AB	CD_AB;DSI_AB;USI_AB
surc	0.19	0.21	0.21	0.25	0.58	0.66	0.67	0.69
DS flow (m3/s)	0.00185	0.00227	0.00281	0.00334	0.00605	0.04381	0.04416	0.04648

Node	301025	301026	301023	301024	301017	2129583	2129582	301201	301204
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole
ground (m AD)	323.826	323.322	322.995	322.521	321.980	321.460	321.580	321.220	321.349
User text 1	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2
User text 2									
Trunk or Focus Area ID						NEW	NEW	TRNK	TRNK
Engineering Validation Check					IPD;BNFS	NewMH;IPD	NewMH	GL_diff	
Engineering Validation Fix					GE_AB	GE_AB	GE_AB	GE_AB	
exprHGL	2.985149	2.651559	2.496740	2.644199	3.179799	2.889962	3.187361	3.096404	3.532441

Note:

Due to the scheduled adjacent storm pipe upgrade through this easement, the ability to meet the design criteria, and the resulting hydraulic performance in the sanitary system, Alternative B is recommended, as per the City's preference.

Solution in model:

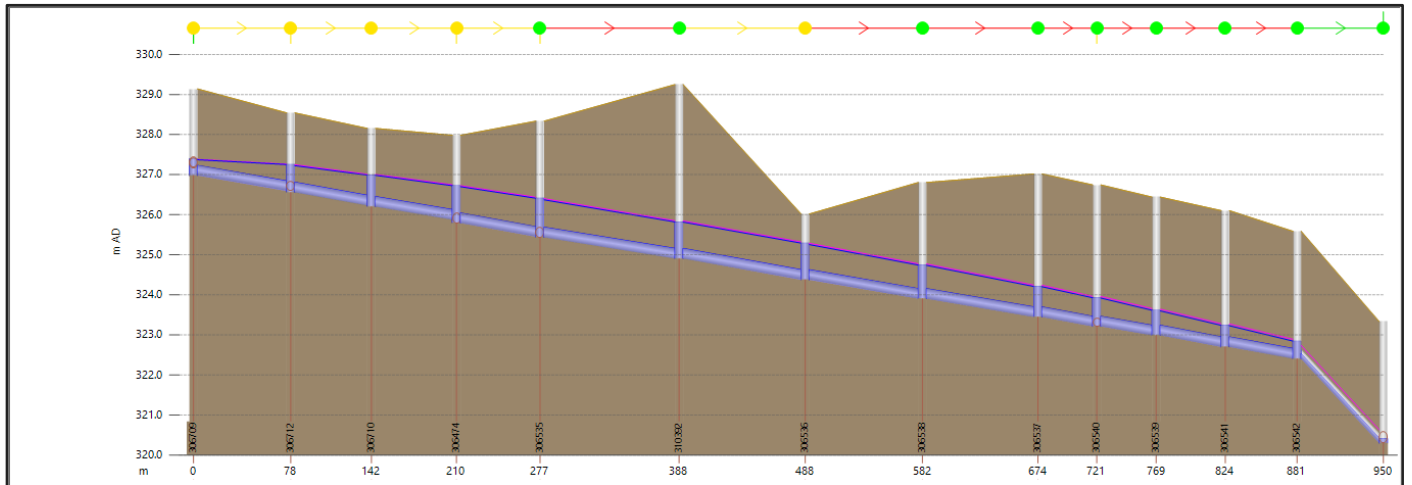
Alternative B - Replacement of 3 lengths of sewer on Dalewood, 2 lengths of sewer on Penrose and one length of sewer through the easement - all pipes upgraded to 300 mm diameter.

TWPAS: Total Wastewater Priority Assessment Score

Existing Conditions - 25yr Results – LOCAL

Upper Schneider Direct - near Ottawa St S

CB-3: Homer Watson Blvd



Link	306709.1	306712.1	306710.1	306474.1	306535.1	310392.1	306536.1	306538.1	306537.1	306540.1	306539.1	306541.1	306542.1
length (m)	77.7	64.3	67.9	66.8	111.0	100.7	93.6	92.1	47.0	47.4	55.2	57.3	68.9
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	250	250	250	250	250	250	250	250	250	250	250	250
us inv (m AD)	326.980	326.560	326.203	325.792	325.438	324.908	324.377	323.905	323.448	323.213	322.990	322.701	322.405
ds inv (m AD)	326.593	326.234	325.877	325.450	324.908	324.377	323.905	323.448	323.213	322.990	322.701	322.411	320.299
grad (m/m)	0.00498	0.00507	0.00480	0.00512	0.00478	0.00527	0.00504	0.00496	0.00500	0.00470	0.00523	0.00507	0.03057
pfc (m3/s)	0.042	0.042	0.041	0.043	0.041	0.043	0.042	0.042	0.042	0.041	0.043	0.042	0.104
Trunk or Focus Area ID	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH
Engineering Validation Check													
Engineering Validation Fix													
surc	1.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	0.49
DS flow (m3/s)	0.02535	0.03898	0.03838	0.03883	0.04152	0.04243	0.04348	0.04449	0.04508	0.04726	0.04770	0.04836	0.04886

Node	306709	306712	306710	306474	306535	310392	306536	306538	306537	306540	306539	306541	306542	-
Node type	-	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-
ground (m AD)	-	328.540	328.153	327.982	328.335	329.248	326.017	326.805	327.018	326.743	326.440	326.101	325.585	-
Trunk or Focus Area ID	-	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-
Engineering Validation Check	GL_diff		GL_diff		IPI									
Engineering Validation Fix					IPI_FX									
expr:HGL	-	1.288383	1.165970	1.259100	1.928048	3.428573	0.729494	2.062660	2.809199	2.816700	2.826261	2.863390	2.745675	-

Note:

Differences observed between the modelled, GIS and DEM ground elevations create uncertainties; however, the HGL issues would remain regardless.

Recommendation:

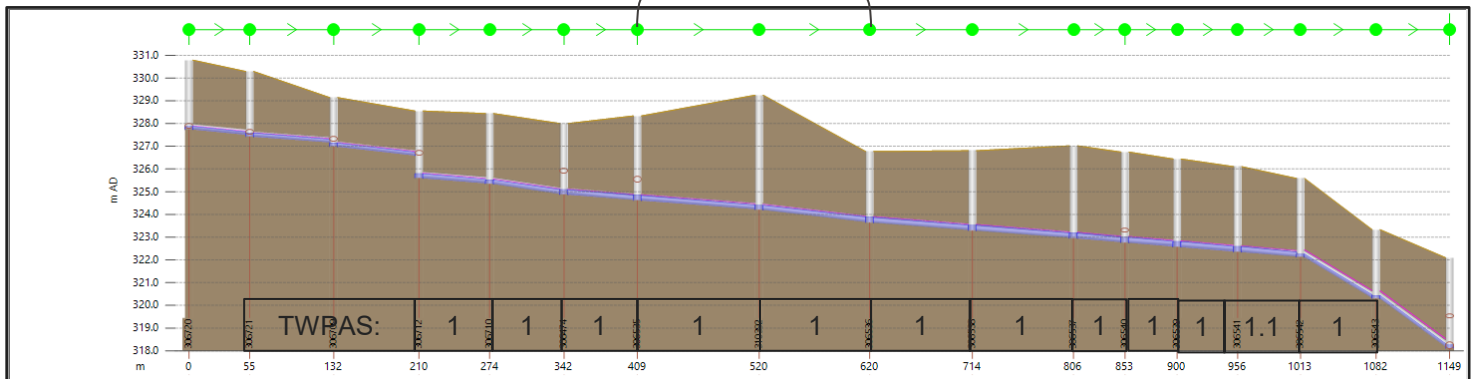
Upgrade the pipes; potentially providing inline storage upstream of pipes in private property.

Existing Conditions Solutions – ALTERNATIVE A - 25yr Results – LOCAL

Upper Schneider Direct - near Ottawa St S

SA-6: Homer Watson Blvd

Private property



Link	306720.1	306721.1	306709.1	306712.1	306710.1	306474.1	306535.1	310392.1	306536.1	306538.1	306537.1	306540.1	306539.1	306541.1	306542.1	306543.1
length (m)	55.4	76.5	77.7	64.3	67.9	66.8	111.0	100.7	93.6	92.1	47.0	47.4	55.2	57.3	68.9	66.9
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	250	250	300	300	300	300	300	300	300	300	300	300	300	300	300
us inv (m AD)	327.736	327.419	326.980	325.590	325.340	324.870	324.612	324.202	323.640	323.290	322.945	322.755	322.562	322.343	322.117	320.299
ds inv (m AD)	327.508	327.172	326.593	325.370	324.900	324.642	324.232	323.670	323.320	322.975	322.785	322.592	322.373	322.147	320.329	318.184
grad (m/m)	0.00412	0.00323	0.00498	0.00342	0.00648	0.00341	0.00342	0.00528	0.00342	0.00342	0.00341	0.00344	0.00342	0.00342	0.02595	0.03160
pfc (m3/s)	0.038	0.034	0.042	0.057	0.078	0.057	0.057	0.070	0.057	0.057	0.056	0.057	0.057	0.057	0.156	0.172
ProblemAreaID			SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6
SolutionTag				Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	-	-	-	Upgrd;Drop	Upgrd;Drop	
Trunk or Focus Area ID	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH
Engineering Validation Check																
Engineering Validation Fix																
expr:DS_Cover	2.5	1.7	1.7	2.8	2.8	3.4	4.7	2.8	3.2	3.7	3.7	3.5	3.4	3.1	2.7	3.6
expr:US_Cover	2.8	2.6	1.9	2.7	2.8	2.8	3.4	4.7	2.8	3.2	3.8	3.7	3.6	3.5	3.2	2.7
surc	0.51	0.60	0.58	0.63	0.61	0.67	0.71	0.69	0.74	0.75	0.75	0.78	0.79	0.79	0.43	0.41
DS flow (m3/s)	0.01909	0.02206	0.02597	0.04092	0.04162	0.04439	0.04769	0.04880	0.05002	0.05117	0.05185	0.05417	0.05466	0.05537	0.05598	0.05666

Node	-	306721	306709	306712	306710	306474	306535	310392	306536	306538	306537	306540	306539	306541	306542	306543	-
Node type	-	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-	Manhole	Manhole	Manhole	Manhole	-
ground (m AD)	-	330.289	329.140	328.550	328.440	328.000	328.335	329.248	326.770	326.805	327.018	326.743	326.440	326.101	325.585	323.329	-
ProblemAreaID			SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6
SolutionTag																	
Trunk or Focus Area ID	-	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-
Engineering Validation Check			GL_diff		GL_diff		IPI										
Engineering Validation Fix				GL_ELEV	GL_ELEV	GL_ELEV	IPI_FX		GL_ELEV								
expr:HGL	-	2.715849	2.008958	2.759564	2.941831	2.917755	3.493203	4.858992	2.893566	3.287849	3.845209	-	3.636106	3.518969	3.338510	2.907156	-

Note:

Cover requirement of 2.8 m is achieved, except at the U/S end of the first upgraded pipe (2.7 m) to respect the minimum velocity requirement, and at the D/S end of the last upgraded pipe (2.7 m) to maintain a drop of 3 cm between it and the existing pipe D/S.

1 x 1350 mm storm sewer crossing located at the red circle shown above.

Solution in model:

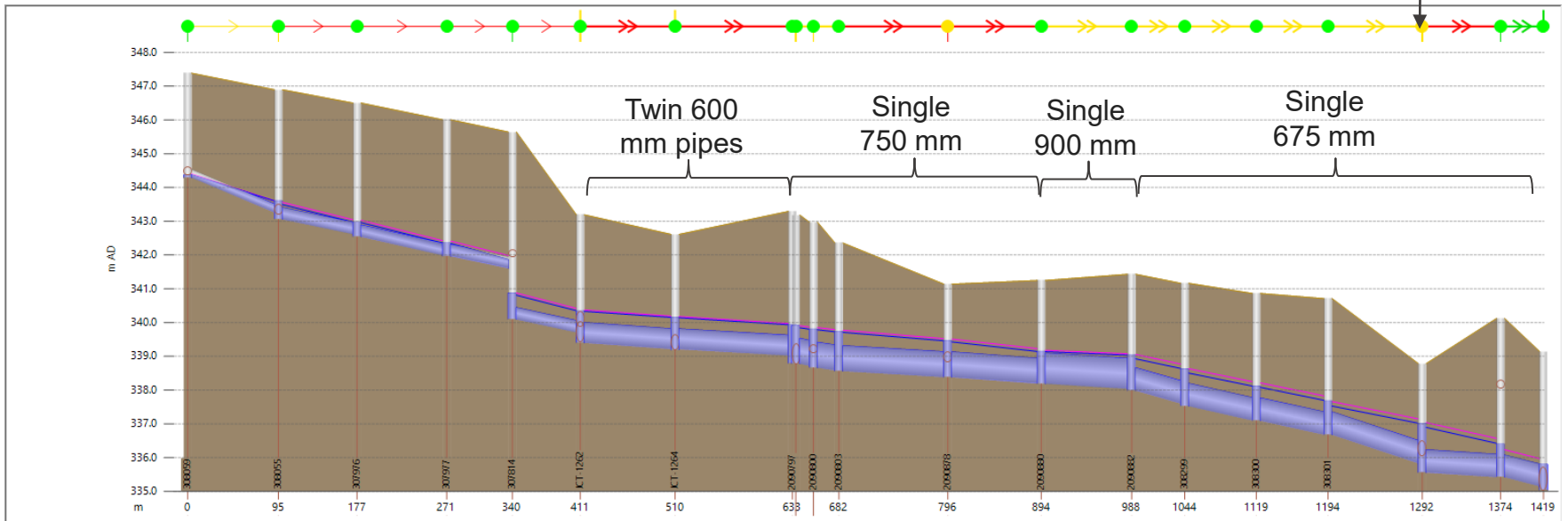
Alternative A – Replacement of 7 lengths of sewer on Homer Watson due to capacity, replacement of 2 lengths of sewer on comm. property due to capacity/condition, replacement of 7 lengths of sewer on Alpine due to capacity/condition, replacement of 2 lengths of sewer on Flint due to capacity, replacement of 1 length of sewer on Kingswood due to condition.

TWPAS: Total Wastewater Priority Assessment Score

Existing Conditions - 25yr Results - TRUNK

Upper Schneider - Near Highland Rd W
CB4 – Sandrock Trunk

DEM: 340.53 m
GIS: 338.785 m
Model: 338.787 m



Link	308059.1	308055.1	307976.1	307977.1	307814.1	JCT-1262.2	JCT-1264.1	-	-	2090803.1	2090878.1	2090880.1	-	308299.1	308300.1	308301.1	307802.1	-
length (m)	94.9	82.3	93.9	68.7	71.2	99.2	122.8	-	26.7	113.9	97.9	94.6	55.5	75.0	75.0	98.6	82.0	44.9
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	-	-	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	350	350	350	350	600	600	-	750	750	750	900	675	675	675	675	675	675
us inv (m AD)	344.293	343.055	342.540	341.964	340.093	339.398	339.212	-	-	338.562	338.378	338.189	337.984	337.523	337.091	336.679	335.557	335.423
ds inv (m AD)	343.260	342.620	341.992	341.605	339.708	339.216	339.023	-	-	338.385	338.192	338.038	337.603	337.100	336.679	335.832	335.423	335.152
grad (m/m)	0.01088	0.00529	0.00584	0.00523	0.00540	0.00184	0.00154	-	-	0.00155	0.00190	0.00160	0.00686	0.00564	0.00549	0.00859	0.00163	0.00603
pfc (m3/s)	0.062	0.106	0.111	0.106	0.107	0.263	0.241	-	-	0.439	0.485	0.723	0.696	0.631	0.623	0.779	0.340	0.653
Trunk or Focus Area ID						TRNK	TRNK						TRNK	TRNK	TRNK	TRNK	TRNK	TRNK
Engineering Validation Check																		
Engineering Validation Fix					DSI_AB								USI_AB					
surc	1.00	2.00	2.00	2.00	2.00	2.00	2.00	-	1.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	2.00	0.97
DS flow (m3/s)	0.01022	0.11498	0.11650	0.11789	0.11990	0.30244	0.25246	-	-	0.51824	0.59516	0.59649	0.59773	0.59884	0.59896	0.59910	0.63332	0.63600

Node	-	308055	307976	307977	307814	JCT-1262	JCT-1264	2090797	-	2090803	2090878	2090880	2090882	308299	308300	308301	307802	307805	-
Node type	-	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-
ground (m AD)	-	346.895	346.500	346.004	345.643	343.190	342.610	343.292	-	342.355	341.138	341.246	341.430	341.163	340.861	340.709	338.787	340.123	-
Trunk or Focus Area ID						TRNK	TRNK	TRNK						TRNK	TRNK	TRNK	TRNK	TRNK	
Engineering Validation Check						-	BNFS;IPD	DNP					IPD						
Engineering Validation Fix						AssetID_GIS													
exprHGL	-	3.291606	3.526489	3.651705	4.767695	2.848295	2.458511	3.360207	-	2.630177	1.681030	2.104368	2.398750	2.535101	2.746040	3.027481	1.781019	3.727919	-

Note:

Capacity constraints throughout due to decreasing pipe sizes, and portions of twinned pipes draining into single-barrel pipes.

Differences observed between the modelled, GIS and DEM ground elevations create uncertainties at node (ID: 307802); the HGL issue would be corrected with the DEM data.

Recommendation:

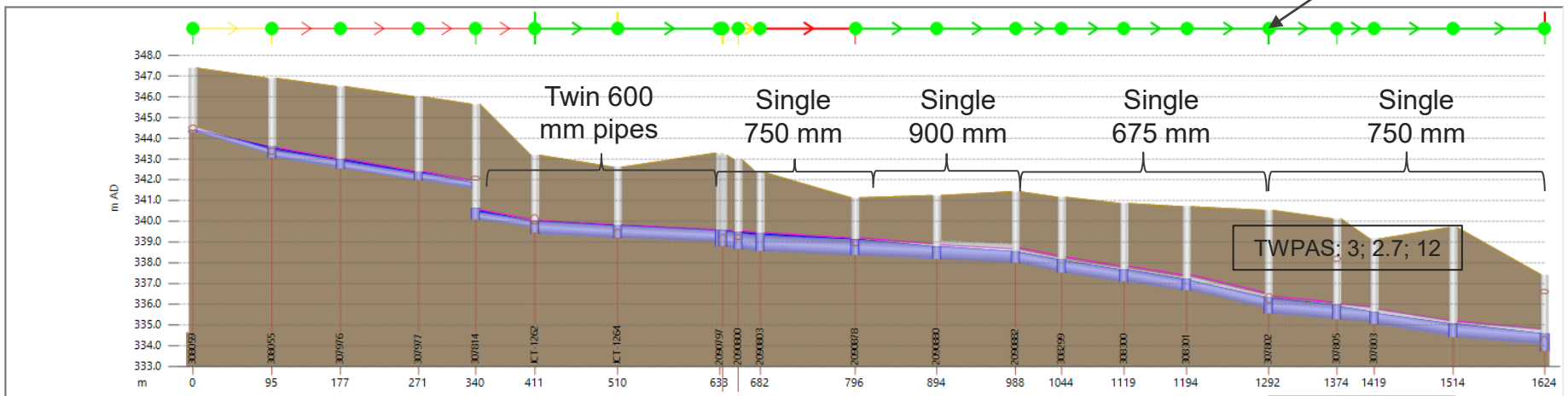
Upgrade the pipes and use the DEM elevation at node 307802.

Existing Conditions Solutions- 25yr Results - TRUNK

Upper Schneider - Near Highland Rd W

SA-7: Sandrock Trunk

DEM: 340.530 m
GIS: 338.785 m
Model: 338.787 m



Link	308059.1	308055.1	307976.1	307977.1	307814.1	JCT-1262.2	JCT-1264.1	-	-	2090803.1	2090878.1	2090880.1	-	308299.1	308300.1	308301.1	307802.1	-	307803.1	305737.1
length (m)	94.9	82.3	93.9	68.7	71.2	99.2	122.8	-	-	113.9	97.9	94.6	55.5	75.0	75.0	98.6	82.0	44.9	94.6	110.2
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	-	-	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	350	350	350	350	600	600	-	750	750	750	900	675	675	675	675	750	750	750	750
us inv (m AD)	344.293	343.055	342.540	341.964	340.093	339.398	339.212	-	-	338.562	338.378	338.189	337.984	337.523	337.091	336.679	335.557	-	335.036	334.411
ds inv (m AD)	343.260	342.620	341.992	341.605	339.708	339.216	339.023	-	-	338.385	338.192	338.038	337.603	337.100	336.679	335.832	335.311	-	334.488	334.085
grad (m/m)	0.01088	0.00529	0.00584	0.00523	0.00540	0.00184	0.00154	-	-	0.00155	0.00190	0.00160	0.00686	0.00564	0.00549	0.00859	0.00300	-	0.00579	0.00296
pfc (m3/s)	0.062	0.106	0.111	0.106	0.107	0.263	0.241	-	-	0.439	0.485	0.723	0.696	0.631	0.623	0.779	0.610	0.597	0.847	0.606
ProblemAreaID	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	-	-	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	
SolutionTag																	Upgrd;Drop	-	Upgrd	
Trunk or Focus Area ID						TRNK	TRNK						TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK
Engineering Validation Check																				
Engineering Validation Fix					DSI_AB								USI_AB							
expr:US_Cover	2.8	3.5	3.6	3.7	5.2	3.2	2.8	-	3.6	3.0	2.0	2.2	2.8	3.0	3.1	3.4	4.2	4.1	3.4	4.5
expr:DS_Cover	3.4	3.5	3.7	3.7	3.1	2.8	3.7	-	3.0	2.0	2.3	2.5	2.9	3.1	3.4	4.0	4.1	3.2	4.5	2.6
surc	1.00	2.00	2.00	2.00	2.00	0.99	0.96	-	-	2.00	0.98	0.65	0.82	0.84	0.82	0.75	0.95	0.77	0.76	0.85
DS flow (m3/s)	0.01022	0.11498	0.11650	0.11789	0.12012	0.30243	0.25805	-	-	0.52917	0.60945	0.61092	0.61216	0.61327	0.61340	0.61356	0.64889	-	0.65177	0.65195

Node	-	308055	307976	307977	307814	JCT-1262	JCT-1264	-		2090803	2090878	2090880	2090882	308299	308300	308301	307802	307805	307803	305737	-
Node type	-	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-		Manhole	Manhole	Manhole	Manhole	-	Manhole	Manhole	Manhole	-	Manhole	Manhole	-
ground (m AD)	-	346.895	346.500	346.004	345.643	343.190	342.610	343.292		342.355	341.138	341.246	341.430	341.163	340.861	340.709	340.530	340.123	339.146	339.701	-
ProblemAreaID	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7		SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	
SolutionTag																					
Trunk or Focus Area ID						TRNK	TRNK	TRNK						TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK
Engineering Validation Check						-	BNFS;IPD	DNP					IPD								-
Engineering Validation Fix						-											GL_ELEV				
expr:HGL	-	3.291576	3.526489	3.651705	-	3.190763	2.818405	-		2.952382	2.010192	2.466612	2.889198	-	3.201515	3.498185	4.199647	-	-	4.640514	-

Note:

2 x 450 mm watermain crossing on the first solution pipe.

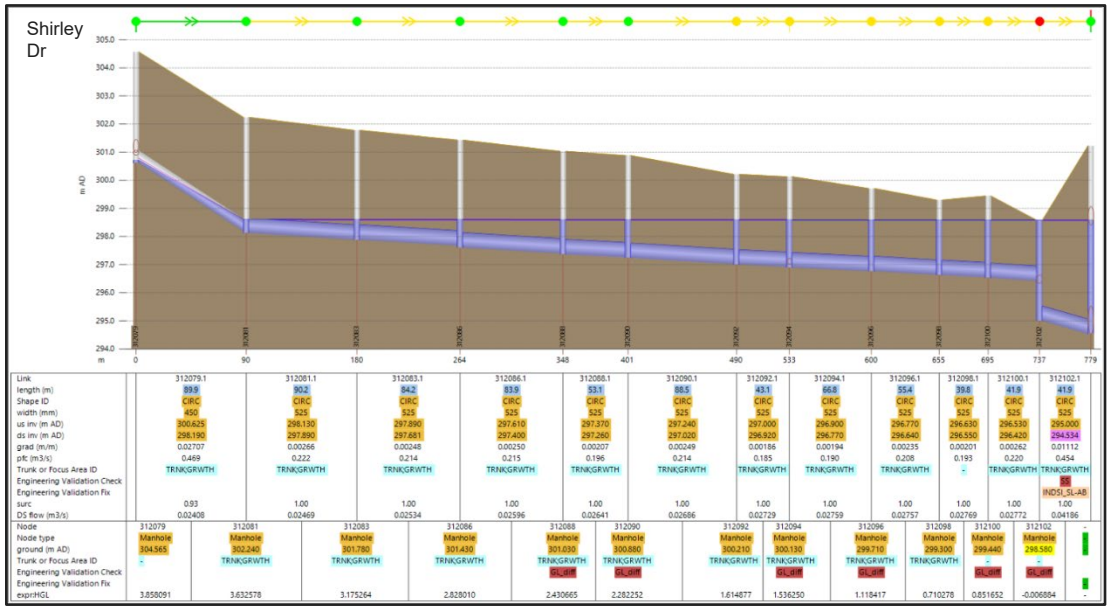
Solution in model:

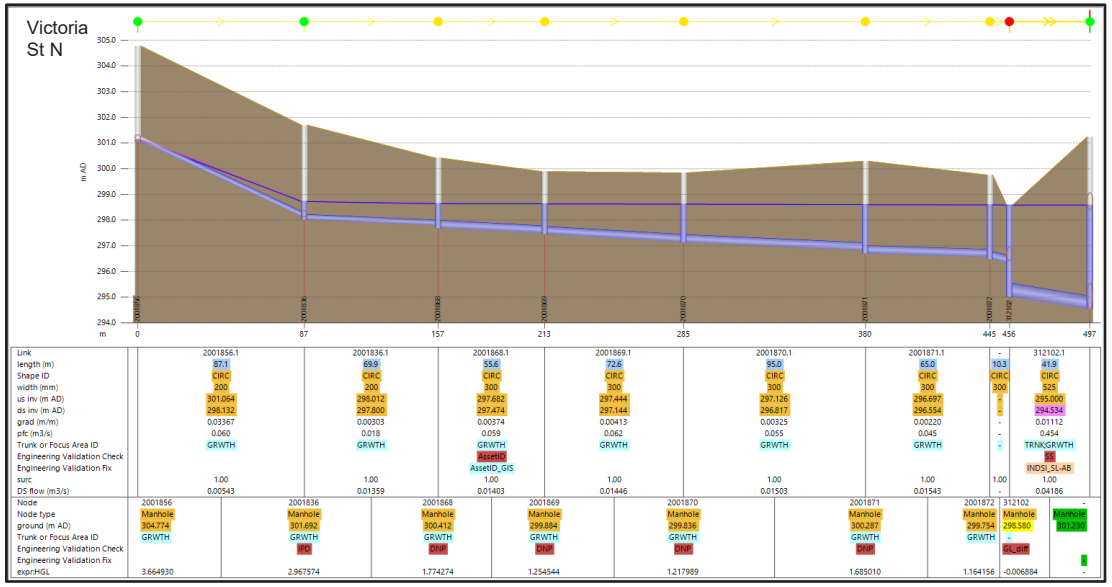
Replacement of 3 lengths of sewer - upsizing from 675 mm diameter to 750 mm diameter sewer

TWPAS: Total Wastewater Priority Assessment Score

Existing Conditions - 25yr Results - TRUNK

Montgomery – Victoria North (1 of 2)
CB5 - Shirley Dr and Victoria St N – U/S of Shirley SPS





Note:

The 25yr peak flow (236 L/s) coming into Shirley SPS is higher than the pump station firm and rated capacities of 207 L/s; which results in upstream backwater.

Surface flooding observed just upstream of the pumping station. Differences observed at this node between the modelled, GIS and DEM ground elevations create uncertainties; however, the HGL issue would remain regardless of correction.

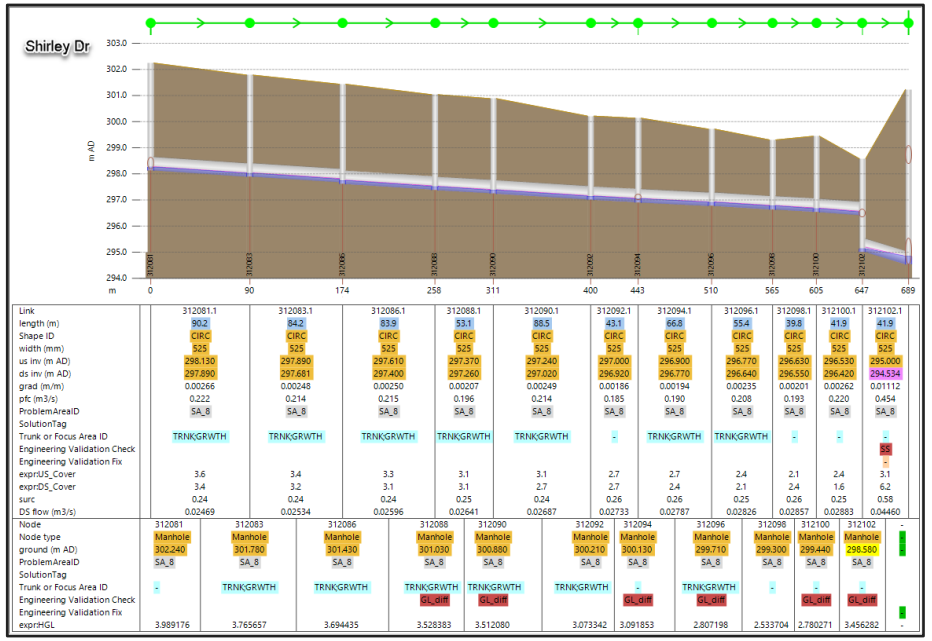
Recommendation:

The ECA's firm capacity for Shirley SPS is 378 L/s; therefore, the recommendation is to upgrade the pump station capacity to within the ECA's approved rate.

Existing Conditions Solutions - 25yr Results -TRUNK

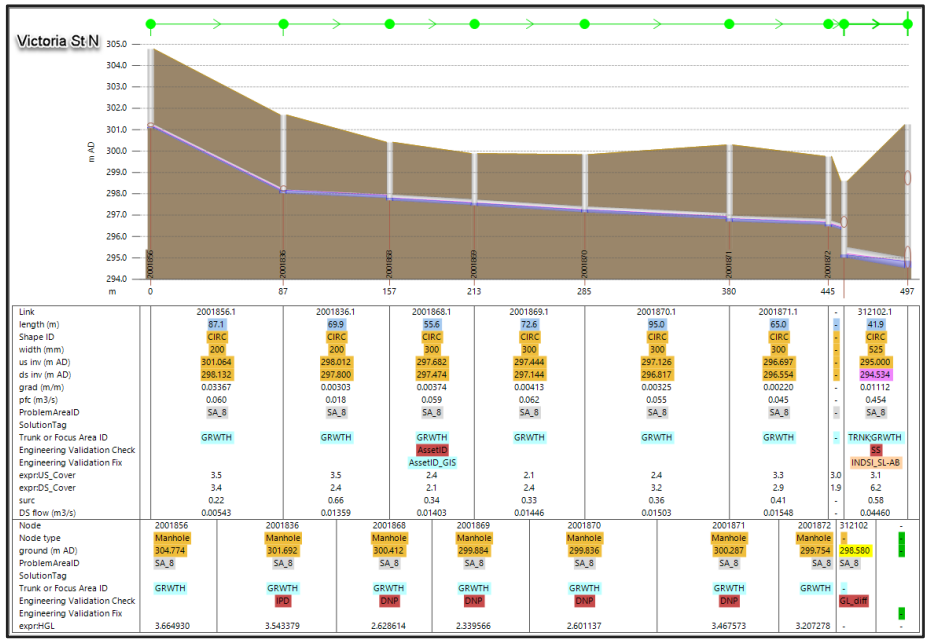
Montgomery – Victoria North

SA_8: Shirley Dr and Victoria St N – U/S of Shirley SPS



Link	312081.1	312083.1	312086.1	312088.1	312090.1	312092.1	312094.1	312096.1	312098.1	312100.1	312102.1
length (m)	90.2	84.2	83.9	53.1	88.5	43.1	66.8	55.4	39.8	41.9	41.9
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	525	525	525	525	525	525	525	525	525	525	525
us inv (m AD)	298.130	297.890	297.610	297.370	297.240	297.000	296.900	296.770	296.630	296.530	295.000
ds inv (m AD)	297.890	297.681	297.400	297.260	297.020	296.920	296.770	296.640	296.550	296.420	294.534
grad (m/m)	0.00266	0.00248	0.00250	0.00207	0.00249	0.00186	0.00194	0.00235	0.00201	0.00262	0.01112
pfc (m3/s)	0.222	0.214	0.215	0.196	0.214	0.185	0.190	0.208	0.193	0.220	0.454
ProblemAreaID	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8
SolutionTag											
Trunk or Focus Area ID	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	-	TRNKGRWTH	TRNKGRWTH	-	-	-
Engineering Validation Check											SS
Engineering Validation Fix											-
exprUS_Cover	3.6	3.4	3.3	3.1	3.1	2.7	2.7	2.4	2.1	2.4	3.1
exprDS_Cover	3.4	3.2	3.1	3.1	2.7	2.7	2.4	2.1	2.4	1.6	6.2
surc	0.24	0.24	0.24	0.25	0.24	0.26	0.26	0.25	0.26	0.25	0.58
DS flow (m3/s)	0.02469	0.02534	0.02596	0.02641	0.02687	0.02733	0.02787	0.02826	0.02857	0.02883	0.04460

Node	312081	312083	312086	312088	312090	312092	312094	312096	312098	312100	312102	-
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	
ground (m AD)	302.240	301.780	301.430	301.030	300.880	300.210	300.130	299.710	299.300	299.440	296.580	
ProblemAreaID	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	
SolutionTag												
Trunk or Focus Area ID	-	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	-	TRNKGRWTH	-	-	-	
Engineering Validation Check				GL_diff	GL_diff		GL_diff	GL_diff		GL_diff	GL_diff	
Engineering Validation Fix												
exprHGL	3.989176	3.765657	3.694435	3.528383	3.512080	3.073342	3.091853	2.807198	2.533704	2.780271	3.456282	-



Link	2001856.1	2001836.1	2001868.1	2001869.1	2001870.1	2001871.1	-	312102.1
length (m)	87.1	69.9	55.6	72.6	95.0	65.0	-	41.9
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	-	CIRC
width (mm)	200	200	300	300	300	300	-	525
us inv (m AD)	301.064	298.012	297.682	297.444	297.126	296.697	-	295.000
ds inv (m AD)	298.132	297.800	297.474	297.144	296.817	296.554	-	294.534
grad (m/m)	0.03367	0.00303	0.00374	0.00413	0.00325	0.00220	-	0.01112
pfc (m3/s)	0.060	0.018	0.059	0.062	0.055	0.045	-	0.454
ProblemAreaID	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	-	SA_8
SolutionTag								
Trunk or Focus Area ID	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-	TRNKGRWTH
Engineering Validation Check			AssetID					SS
Engineering Validation Fix			AssetID_GIS					INDSI_SL-AB
exprUS_Cover	3.5	3.5	2.4	2.1	2.4	3.3	3.0	3.1
exprDS_Cover	3.4	2.4	2.1	2.4	3.2	2.9	1.9	6.2
surc	0.22	0.66	0.34	0.33	0.36	0.41	-	0.58
DS flow (m3/s)	0.00543	0.01359	0.01403	0.01446	0.01503	0.01548	-	0.04460

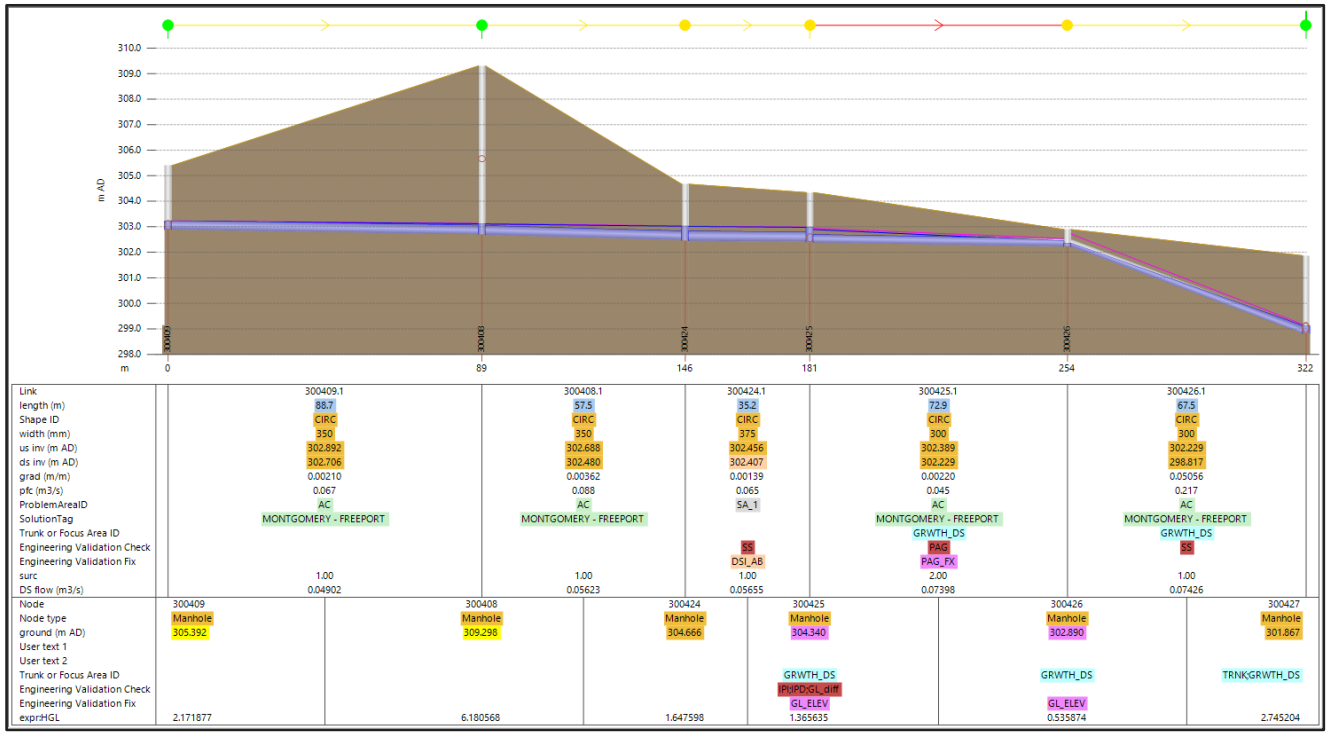
Node	2001856	2001836	2001868	2001869	2001870	2001871	2001872	312102	-
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-	
ground (m AD)	304.774	301.692	300.412	299.884	299.836	300.287	299.754	296.580	
ProblemAreaID	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	
SolutionTag									
Trunk or Focus Area ID	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-	
Engineering Validation Check		IPD	DNP	DNP	DNP	DNP		GL_diff	
Engineering Validation Fix									
exprHGL	3.664930	3.543379	2.628614	2.339566	2.601137	3.467573	3.207278	-	-

<u>Solution in model:</u>

Increase PS capacity to 378 L/s firm capacity - project involves addition of pumps to accommodate higher flows. ECA update not required.

2031 Conditions - 25yr Results - LOCAL

Montgomery – Freeport
CB-1: U/S of King St SPS



Link	300409.1	300408.1	300424.1	300425.1	300426.1
length (m)	88.7	57.5	35.2	72.9	67.5
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	350	350	375	300	300
us inv (m AD)	302.892	302.688	302.456	302.389	302.229
ds inv (m AD)	302.706	302.480	302.407	302.229	298.817
grad (m/m)	0.00210	0.00362	0.00139	0.00220	0.05056
pfc (m3/s)	0.067	0.088	0.065	0.045	0.217
ProblemAreaID	AC	AC	SA_1	AC	AC
SolutionTag	MONTGOMERY - FREEPORT	MONTGOMERY - FREEPORT		MONTGOMERY - FREEPORT	MONTGOMERY - FREEPORT
Trunk or Focus Area ID				GRWTH_DS	GRWTH_DS
Engineering Validation Check			SS	PAG	SS
Engineering Validation Fix			DSI_AB	PAG_FX	
surc	1.00	1.00	1.00	2.00	1.00
DS flow (m3/s)	0.04902	0.05623	0.05655	0.07398	0.07426

Node	300409	300408	300424	300425	300426	300427
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole
ground (m AD)	305.392	309.298	304.666	304.340	302.890	301.867
User text 1						
User text 2						
Trunk or Focus Area ID				GRWTH_DS	GRWTH_DS	TRNK:GRWTH_DS
Engineering Validation Check				PtrPD:GL_diff		
Engineering Validation Fix				GL_ELEV	GL_ELEV	
exprHGL	2.171877	6.180568	1.647598	1.365635	0.535874	2.745204

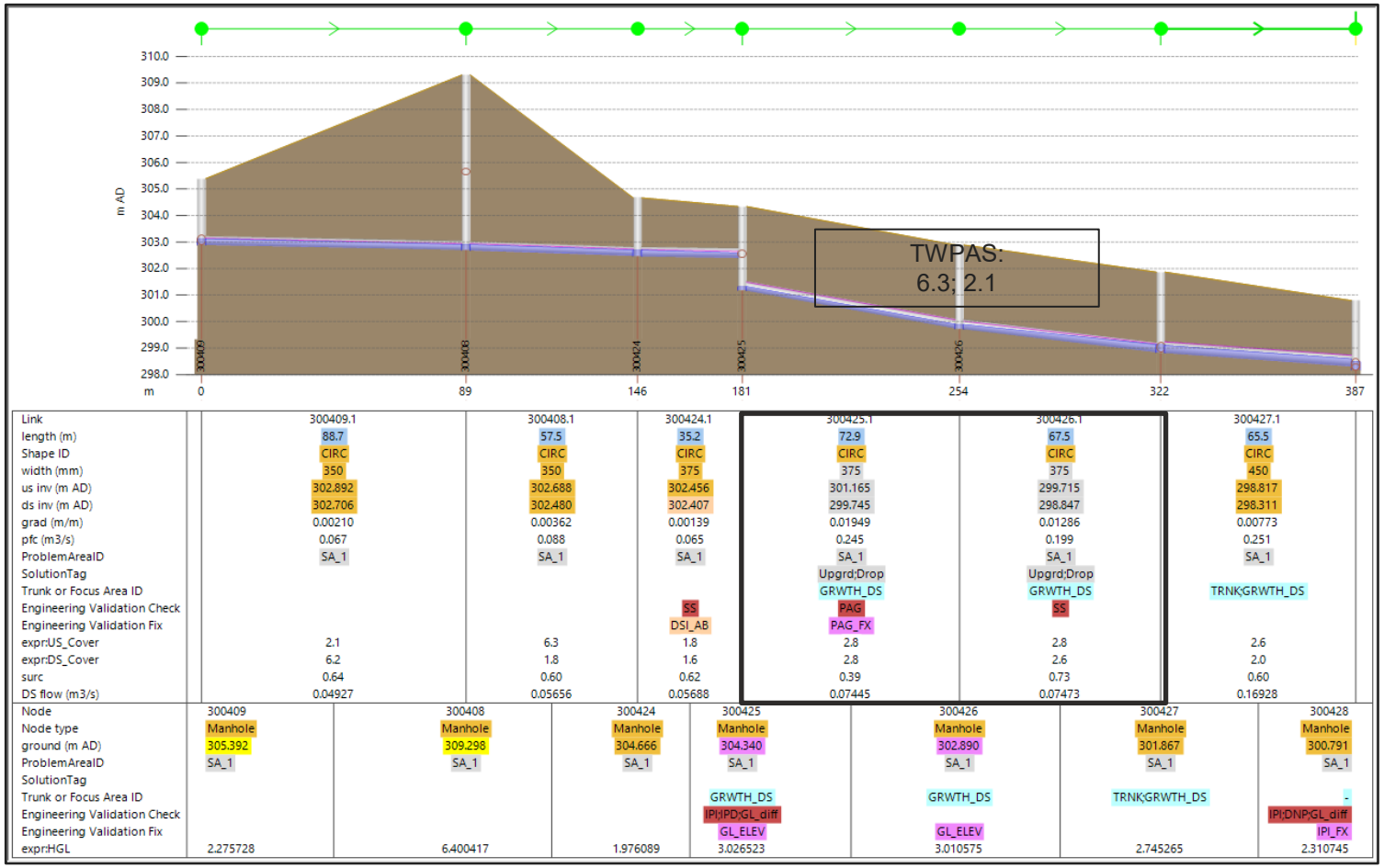
Note:

Same HGL and surcharge issues observed as the existing scenario.

See note & recommendation for existing conditions.

2031 Conditions Solutions - 25yr Results - LOCAL

Montgomery – Freeport
SA_1: U/S of King St SPS



Link	300409.1	300408.1	300424.1	300425.1	300426.1	300427.1
length (m)	88.7	57.5	35.2	72.9	67.5	65.5
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	350	350	375	375	375	450
us inv (m AD)	302.892	302.688	302.456	301.165	299.715	298.817
ds inv (m AD)	302.706	302.480	302.407	299.745	298.847	298.311
grad (m/m)	0.00210	0.00362	0.00139	0.01949	0.01286	0.00773
pfc (m3/s)	0.067	0.088	0.065	0.245	0.199	0.251
ProblemAreaID	SA_1	SA_1	SA_1	SA_1	SA_1	SA_1
SolutionTag				Upgrd:Drop	Upgrd:Drop	
Trunk or Focus Area ID				GRWTH_DS	GRWTH_DS	TRNK;GRWTH_DS
Engineering Validation Check			SS	PAG	SS	
Engineering Validation Fix			DSI_AB	PAG_FX		
expr:US_Cover	2.1	6.3	1.8	2.8	2.8	2.6
expr:DS_Cover	6.2	1.8	1.6	2.8	2.6	2.0
surc	0.64	0.60	0.62	0.39	0.73	0.60
DS flow (m3/s)	0.04927	0.05656	0.05688	0.07445	0.07473	0.16928

Node	300409	300408	300424	300425	300426	300427	300428
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole
ground (m AD)	305.392	309.298	304.666	304.340	302.890	301.867	300.791
ProblemAreaID	SA_1	SA_1	SA_1	SA_1	SA_1	SA_1	SA_1
SolutionTag							
Trunk or Focus Area ID				GRWTH_DS	GRWTH_DS	TRNK;GRWTH_DS	-
Engineering Validation Check				IPI;IPD;GL_diff			IPI;DNP;GL_diff
Engineering Validation Fix				GL_ELEV	GL_ELEV		IPI_FX
expr:HGL	2.275728	6.400417	1.976089	3.026523	3.010575	2.745265	2.310745

<u>Solution in model:</u>

Same solution as the existing scenario.

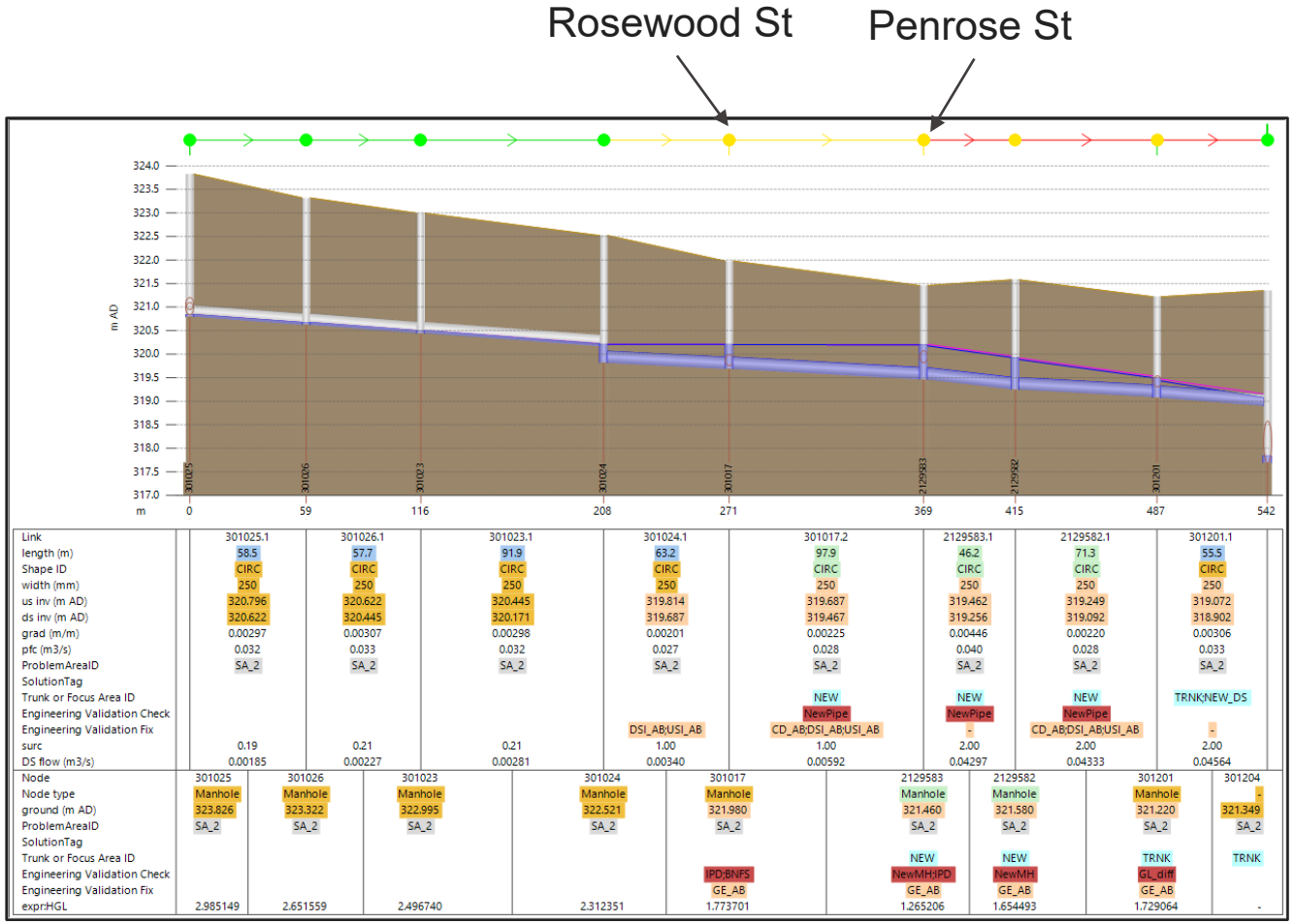
See note & solution for existing conditions solutions.

TWPAS: Total Wastewater Priority Assessment Score

2031 Conditions - 25yr Results - LOCAL

Montgomery – Manchester Direct

CB-2: Dalewood Dr



Link	301025.1	301026.1	301023.1	301024.1	301017.2	2129583.1	2129582.1	301201.1
length (m)	58.5	57.7	91.9	63.2	97.9	46.2	71.3	55.5
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	250	250	250	250	250	250	250
us inv (m AD)	320.796	320.622	320.445	319.814	319.687	319.462	319.249	319.072
ds inv (m AD)	320.622	320.445	320.171	319.687	319.467	319.256	319.092	318.902
grad (m/m)	0.00297	0.00307	0.00298	0.00201	0.00225	0.00446	0.00220	0.00306
pfc (m3/s)	0.032	0.033	0.032	0.027	0.028	0.040	0.028	0.033
ProblemAreaID	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2
SolutionTag								
Trunk or Focus Area ID					NEW	NEW	NEW	TRNK;NEW_DS
Engineering Validation Check					NewPipe	NewPipe	NewPipe	
Engineering Validation Fix				DSI_AB;USI_AB	CD_AB;DSI_AB;USI_AB	-	CD_AB;DSI_AB;USI_AB	-
surc	0.19	0.21	0.21	1.00	1.00	2.00	2.00	2.00
DS flow (m3/s)	0.00185	0.00227	0.00281	0.00340	0.00592	0.04297	0.04333	0.04564

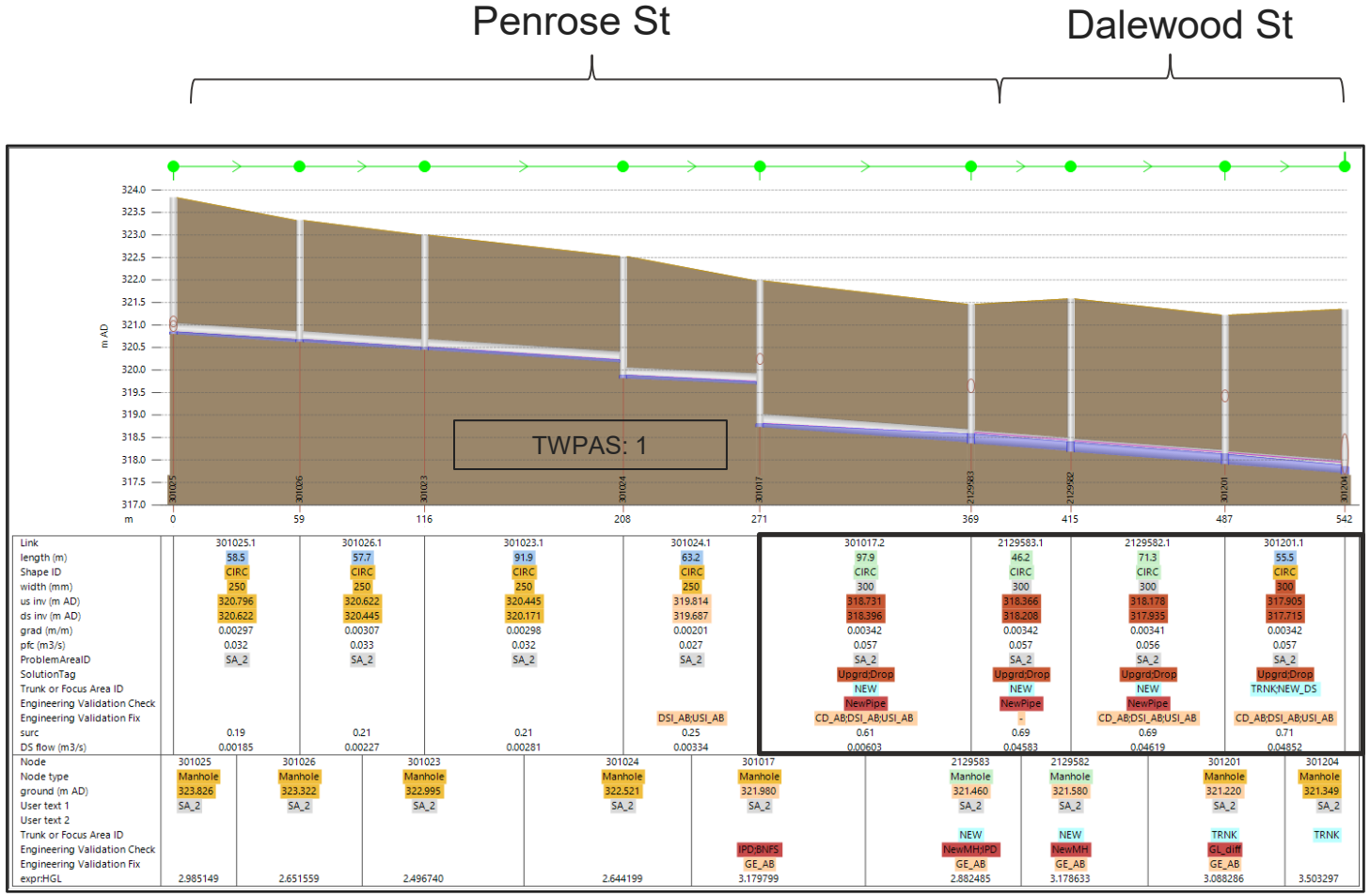
Node	301025	301026	301023	301024	301017	2129583	2129582	301201	301204
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-
ground (m AD)	323.826	323.322	322.995	322.521	321.980	321.460	321.580	321.220	321.349
ProblemAreaID	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2
SolutionTag									
Trunk or Focus Area ID						NEW	NEW	TRNK	TRNK
Engineering Validation Check					IPD;BNFS	NewMH;IPD	NewMH	GL_diff	
Engineering Validation Fix					GE_AB	GE_AB	GE_AB	GE_AB	
exprHGL	2.985149	2.651559	2.496740	2.312351	1.773701	1.265206	1.654493	1.729064	-

Note:
Same HGL and surcharge issues observed as the existing scenario.
See note & recommendation for existing conditions.

2031 Conditions Solutions - 25yr Results - LOCAL

Montgomery – Manchester Direct

SA-2: Dalewood Dr



Link	301025.1	301026.1	301023.1	301024.1	301017.2	2129583.1	2129582.1	301201.1
length (m)	58.5	57.7	91.9	63.2	97.9	46.2	71.3	55.5
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	250	250	250	300	300	300	300
us inv (m AD)	320.796	320.622	320.445	319.814	318.731	318.366	318.178	317.905
ds inv (m AD)	320.622	320.445	320.171	319.687	318.396	318.208	317.935	317.715
grad (m/m)	0.00297	0.00307	0.00298	0.00201	0.00342	0.00342	0.00341	0.00342
pfc (m3/s)	0.032	0.033	0.032	0.027	0.057	0.057	0.056	0.057
ProblemAreaID	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2
SolutionTag					Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop
Trunk or Focus Area ID					NEW	NEW	NEW	TRNK;NEW_DS
Engineering Validation Check					NewPipe	NewPipe	NewPipe	
Engineering Validation Fix				DSI_AB;USI_AB	CD_AB;DSI_AB;USI_AB	-	CD_AB;DSI_AB;USI_AB	CD_AB;DSI_AB;USI_AB
surc	0.19	0.21	0.21	0.25	0.61	0.69	0.69	0.71
DS flow (m3/s)	0.00185	0.00227	0.00281	0.00334	0.00603	0.04583	0.04619	0.04852

Node	301025	301026	301023	301024	301017	2129583	2129582	301201	301204
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole
ground (m AD)	323.826	323.322	322.995	322.521	321.980	321.460	321.580	321.220	321.349
User text 1	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2
User text 2									
Trunk or Focus Area ID						NEW	NEW	TRNK	TRNK
Engineering Validation Check					IPD;BNFS	NewMH;IPD	NewMH	GL_diff	
Engineering Validation Fix					GE_AB	GE_AB	GE_AB	GE_AB	
exprHGL	2.985149	2.651559	2.496740	2.644199	3.179799	2.882485	3.178633	3.088286	3.503297

<u>Solution in model:</u>

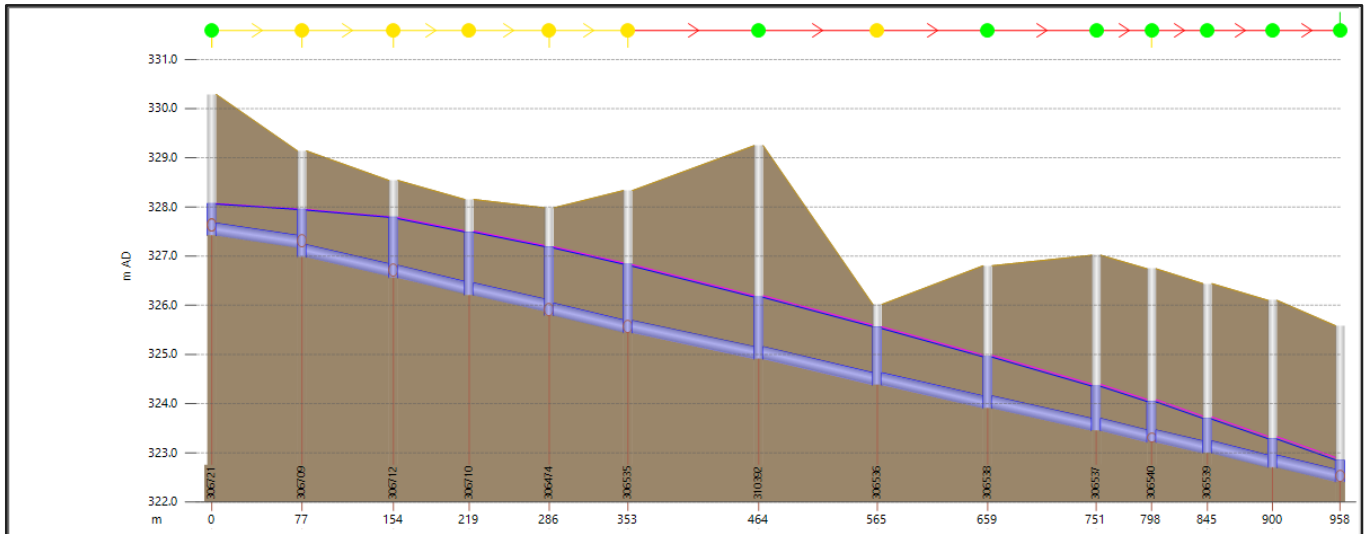
Same solution as the existing scenario.

See note & solution for existing conditions solutions.

TWPAS: Total Wastewater Priority Assessment Score

2031 Conditions - 25yr Results – LOCAL

Upper Schneider Direct - near Ottawa St S
CB-3: Homer Watson Blvd



Link	306721.1	306709.1	306712.1	306710.1	306474.1	306535.1	310392.1	306536.1	306538.1	306537.1	306540.1	306539.1	306541.1
length (m)	76.5	77.7	64.3	67.9	66.8	111.0	100.7	93.6	92.1	47.0	47.4	55.2	57.3
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	250	250	250	250	250	250	250	250	250	250	250	250
us inv (m AD)	327.419	326.980	326.560	326.203	325.792	325.438	324.908	324.377	323.905	323.448	323.213	322.990	322.701
ds inv (m AD)	327.172	326.593	326.234	325.877	325.450	324.908	324.377	323.905	323.448	323.213	322.990	322.701	322.411
grad (m/m)	0.00323	0.00498	0.00507	0.00480	0.00512	0.00478	0.00527	0.00504	0.00496	0.00500	0.00470	0.00523	0.00507
pfc (m3/s)	0.034	0.042	0.042	0.041	0.043	0.041	0.043	0.042	0.042	0.042	0.041	0.043	0.042
Trunk or Focus Area ID	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH
Engineering Validation Check													
Engineering Validation Fix													
surc	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
DS flow (m3/s)	0.02554	0.02856	0.03964	0.03962	0.04122	0.04421	0.04521	0.04609	0.04698	0.04753	0.04936	0.04978	0.05067

Node	-	306709	306712	306710	306474	306535	310392	306536	306538	306537	306540	306539	306541	-
Node type	-	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-	-	Manhole	-
ground (m AD)	-	329.140	328.540	328.153	327.982	328.335	329.248	326.017	326.805	327.018	-	326.440	326.101	-
Trunk or Focus Area ID	-	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-	GRWTH	GRWTH	-
Engineering Validation Check		GL_diff		GL_diff		IPI								
Engineering Validation Fix						IPI_FX								
expr:HGL	-	1.190262	0.750327	0.662460	0.791448	1.502603	3.081466	0.454836	1.853798	2.661341	-	-	2.814318	-

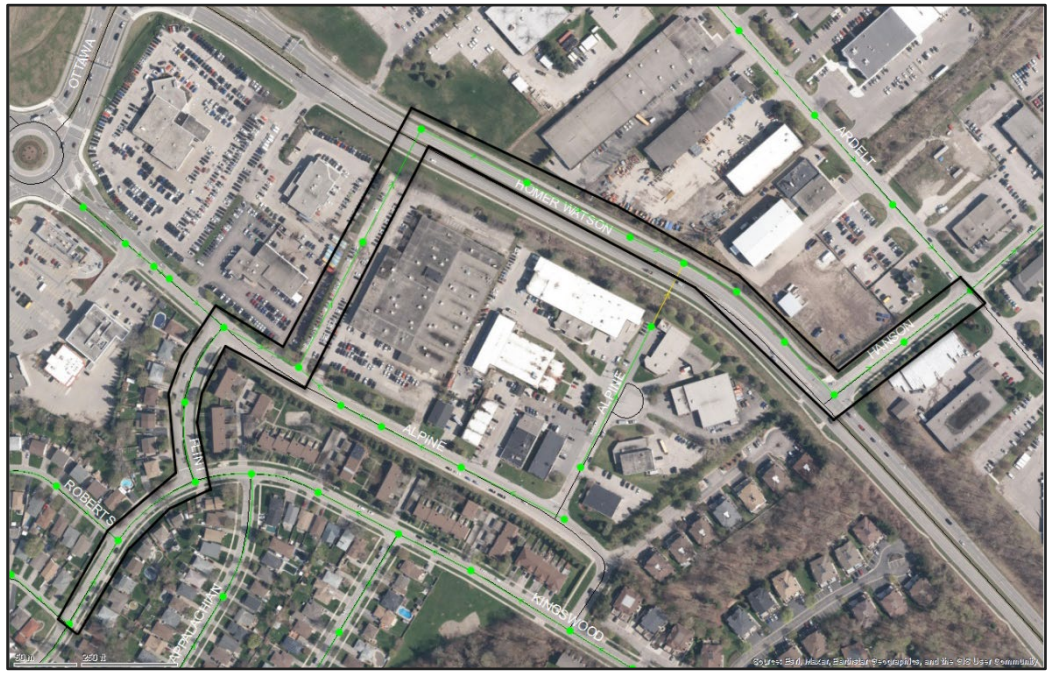
Note:
More surcharge issues observed in the 2031 scenario than in the existing scenario.

Recommendation:
Upgrade the pipes; potentially providing inline storage upstream of pipes in private property.

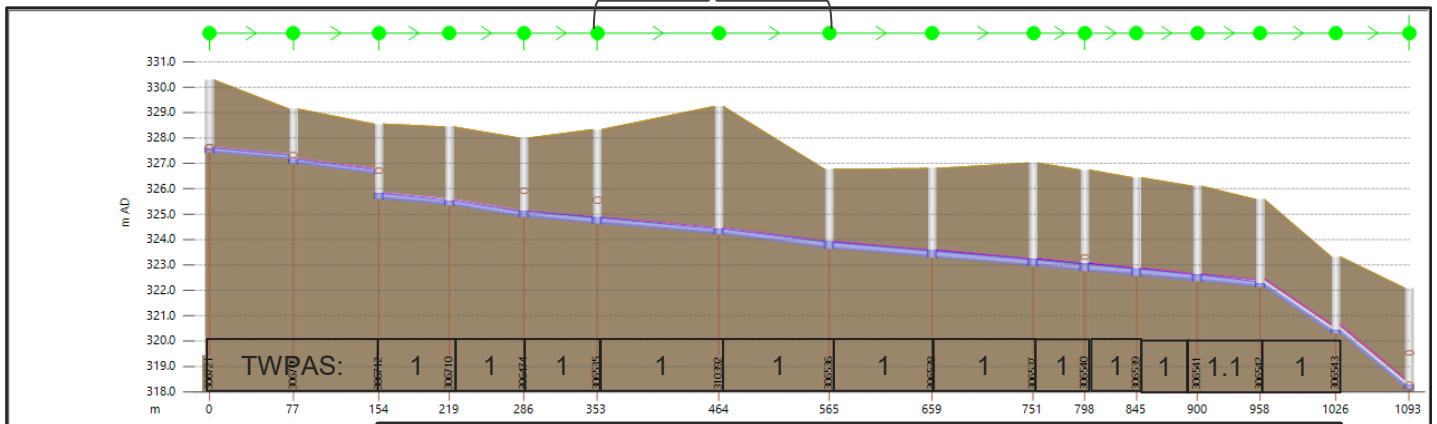
2031 Conditions Solutions – ALTERNATIVE A - 25yr Results – LOCAL

Upper Schneider Direct - near Ottawa St S

SA-6: Homer Watson Blvd



Private property



Link	306721.1	306709.1	306712.1	306710.1	306474.1	306535.1	310392.1	306536.1	306538.1	-	-	306539.1	306541.1	306542.1	306543.1
length (m)	76.5	77.7	64.3	67.9	66.8	111.0	100.7	93.6	92.1	47.0	47.4	55.2	57.3	68.9	66.9
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	250	300	300	300	300	300	300	300	300	300	300	300	300	300
us inv (m AD)	327.419	326.980	325.590	325.340	324.870	324.612	324.202	323.640	323.290	322.945	322.755	322.562	322.343	322.117	320.299
ds inv (m AD)	327.172	326.593	325.370	324.900	324.642	324.232	323.670	323.320	322.975	322.785	322.592	322.373	322.147	320.329	318.184
grad (m/m)	0.00323	0.00498	0.00342	0.00648	0.00341	0.00342	0.00528	0.00342	0.00342	0.00341	0.00344	0.00342	0.00342	0.02595	0.03160
pfc (m3/s)	0.034	0.042	0.057	0.078	0.057	0.057	0.070	0.057	0.057	0.056	0.057	0.057	0.057	0.156	0.172
ProblemAreaID		SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6
SolutionTag			Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	-	-	-	-	Upgrd;Drop	
Trunk or Focus Area ID	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH
Engineering Validation Check															
Engineering Validation Fix															
expr:DS_Cover	1.7	1.7	2.8	2.8	3.4	4.7	2.8	3.2	3.7	3.7	3.5	3.4	3.1	2.7	3.6
expr:US_Cover	2.6	1.9	2.7	2.8	2.8	3.4	4.7	2.8	3.2	3.8	3.7	3.6	3.5	3.2	2.7
surc	0.66	0.63	0.68	0.68	0.75	0.77	0.80	0.82	0.87	0.89	0.94	0.92	0.88	0.45	0.43
DS flow (m3/s)	0.02587	0.02979	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.06131

Node	-	306709	306712	306710	306474	306535	310392	306536	306538	306537	-	306539	306541	306542	306543	-
Node type	-	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-	-	Manhole	Manhole	Manhole	-
ground (m AD)	-	329.140	328.550	328.440	328.000	328.335	329.248	326.770	326.805	327.018	-	326.440	326.101	325.585	323.329	-
ProblemAreaID		SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	-
SolutionTag																
Trunk or Focus Area ID	-	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-	GRWTH	GRWTH	GRWTH	GRWTH	-
Engineering Validation Check		GL_diff		GL_diff		IPI										
Engineering Validation Fix			GL_ELEV	GL_ELEV	GL_ELEV	IPI_FX		GL_ELEV								
expr:HGL	-	1.990189	2.740857	2.930906	2.896576	3.468270	4.844741	2.862255	3.250190	3.801508	-	-	-	3.332864	2.901998	-

<u>Solution in model:</u>

Same solution as the existing scenario.

See note & solution for existing conditions solutions.

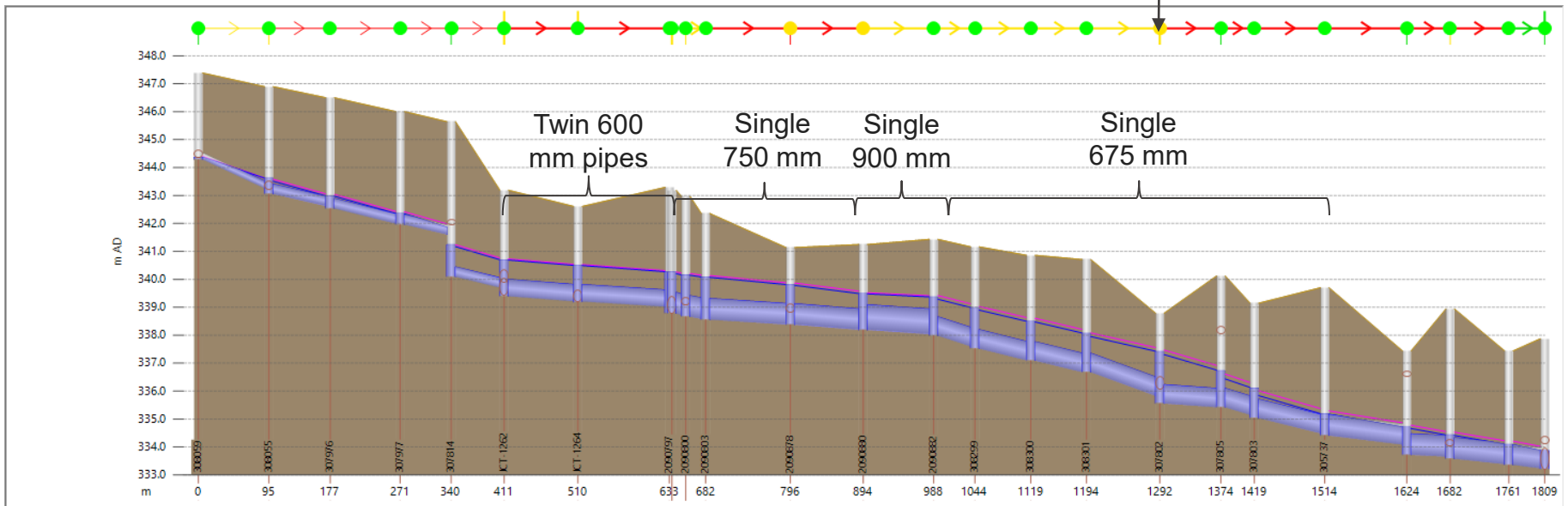
TWPAS: Total Wastewater Priority Assessment Score

2031 Conditions - 25yr Results - TRUNK

Upper Schneider - Near Highland Rd W

CB-4: Sandrock Trunk

DEM: 340.53 m
GIS: 338.785 m
Model: 338.787 m



Link	308059.1	308055.1	307976.1	-	307814.1	JCT-1262.2	JCT-1264.1	-	-	2090803.1	2090878.1	2090880.1	-	308299.1	308300.1	308301.1	307802.1	-	307803.1	305737.1	-	305790.1	-
length (m)	94.9	82.3	93.9	68.7	71.2	99.2	122.8	-	-	113.9	97.9	94.6	55.5	75.0	75.0	98.6	82.0	44.9	94.6	110.2	58.4	78.9	48.0
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	-	-	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	350	350	350	350	600	600	-	-	750	750	900	675	675	675	675	675	675	675	750	750	750	750
us inv (m AD)	344.293	343.055	342.540	341.964	340.093	339.398	339.212	-	-	338.562	338.378	338.189	-	337.523	337.091	336.679	335.557	-	335.036	334.411	-	333.582	-
ds inv (m AD)	343.260	342.620	341.992	341.605	339.708	339.216	339.023	-	-	338.385	338.192	338.038	-	337.100	336.679	335.832	335.423	-	334.488	334.085	-	333.384	-
grad (m/m)	0.01088	0.00529	0.00584	0.00523	0.00540	0.00184	0.00154	-	-	0.00155	0.00190	0.00160	-	0.00564	0.00549	0.00859	0.00163	-	0.00579	0.00296	-	0.00251	-
pfc (m3/s)	0.062	0.106	0.111	0.106	0.107	0.263	0.241	-	-	0.439	0.485	0.723	0.696	0.631	0.623	0.779	0.340	0.653	0.640	0.606	0.360	0.558	0.568
Trunk or Focus Area ID						TRNK	TRNK						TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	-
Engineering Validation Check																							
Engineering Validation Fix					DSI_AB								USI_AB										
surc	1.00	2.00	2.00	2.00	2.00	2.00	2.00	-	-	2.00	2.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	0.96
DS flow (m3/s)	0.01071	0.11562	0.11715	0.11855	0.12051	0.30242	0.25621	-	-	0.52729	0.60493	0.60647	-	0.60888	0.60902	0.60918	0.68680	-	0.68990	0.68984	-	0.69075	-

Node	-	308055	307976	307977	307814	JCT-1262	JCT-1264	-	-	-	2090878	2090880	-	-	308300	308301	307802	-	307803	305737	2087961	305790	-
Node type	-	Manhole	Manhole	Manhole	-	Manhole	Manhole	-	-	-	Manhole	Manhole	-	-	-	Manhole	Manhole	-	-	Manhole	Manhole	-	-
ground (m AD)	-	346.895	346.500	346.004	-	343.190	342.610	-	-	-	341.138	341.246	341.430	-	340.861	340.709	338.787	-	-	339.701	337.438	-	-
Trunk or Focus Area ID						TRNK	TRNK	TRNK						TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK
Engineering Validation Check						-	BNFS;IPD	DNP					IPD								GL_diff	-	
Engineering Validation Fix						-																	
expr:HGL	-	3.274578	3.513306	3.646212	-	2.493711	2.112655	-	-	-	1.327514	1.756559	-	-	-	2.643204	1.368635	-	-	4.510723	2.729748	-	-

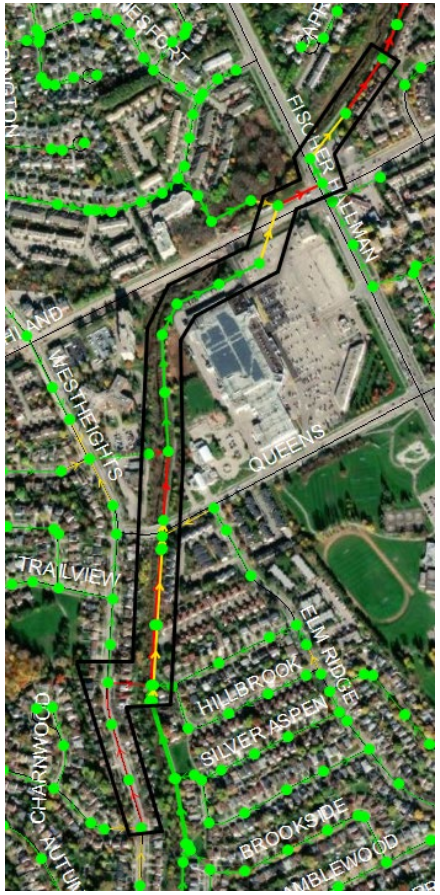
Note:
More HGL and surcharge issues observed in the 2031 scenario than in the existing scenario.

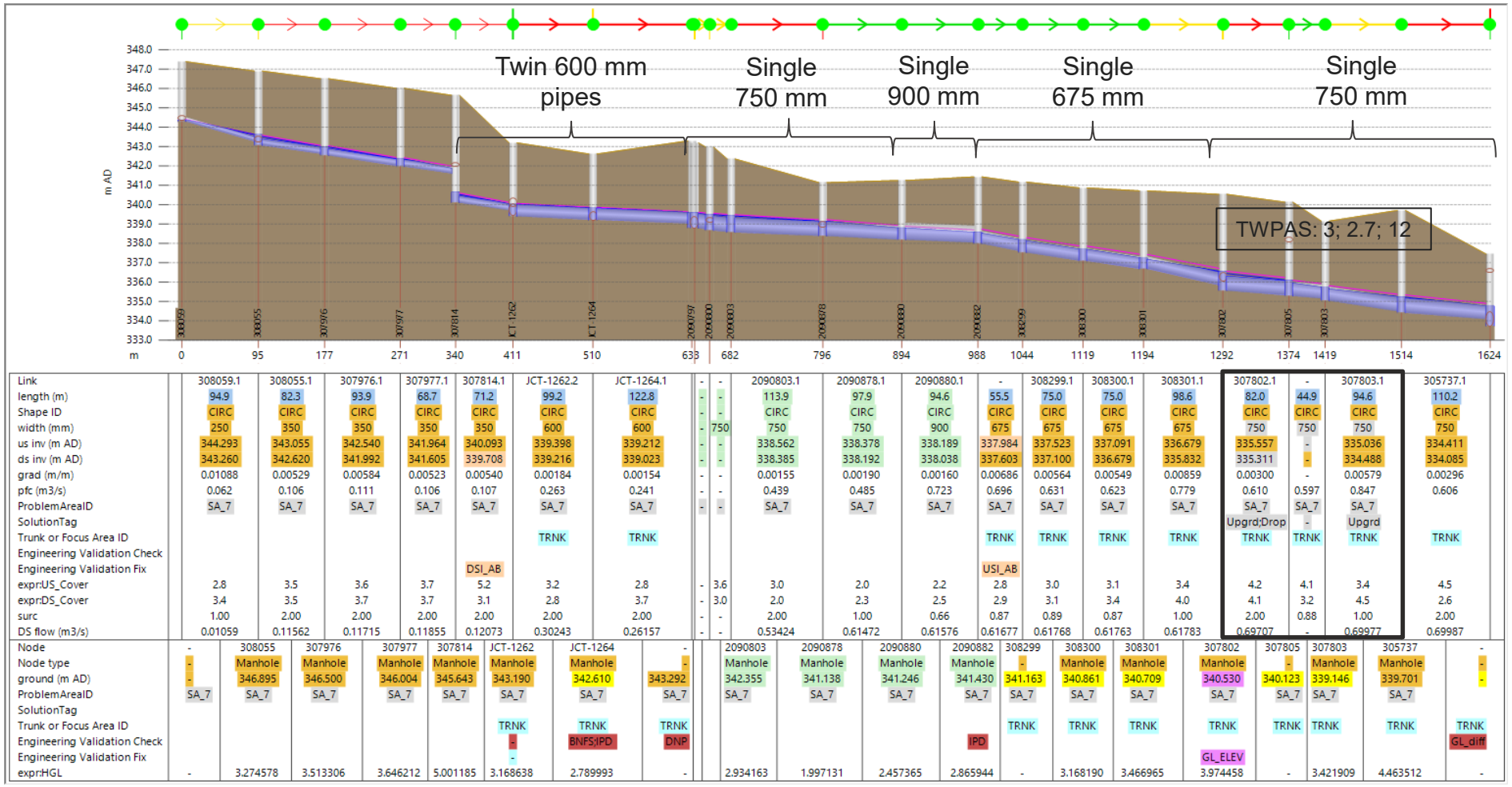
Recommendation:
Upgrade the pipes.

2031 Conditions Solutions - 25yr Results - TRUNK

Upper Schneider - Near Highland Rd W

SA-7: Sandrock Trunk





Link	308059.1	308055.1	307976.1	307977.1	307814.1	JCT-1262.2	JCT-1264.1	-	-	2090803.1	2090878.1	2090880.1	-	308299.1	308300.1	308301.1	307802.1	-	307803.1	305737.1
length (m)	94.9	82.3	93.9	68.7	71.2	99.2	122.8	-	-	113.9	97.9	94.6	55.5	75.0	75.0	98.6	82.0	44.9	94.6	110.2
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	-	-	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	350	350	350	350	600	600	-	750	750	750	900	675	675	675	675	750	750	750	750
us inv (m AD)	344.293	343.055	342.540	341.964	340.093	339.398	339.212	-	-	338.562	338.378	338.189	337.984	337.523	337.091	336.679	335.557	-	335.036	334.411
ds inv (m AD)	343.260	342.620	341.992	341.605	339.708	339.216	339.023	-	-	338.385	338.192	338.038	337.603	337.100	336.679	335.832	335.311	-	334.488	334.085
grad (m/m)	0.01088	0.00529	0.00584	0.00523	0.00540	0.00184	0.00154	-	-	0.00155	0.00190	0.00160	0.00686	0.00564	0.00549	0.00859	0.00300	-	0.00579	0.00296
pfc (m3/s)	0.062	0.106	0.111	0.106	0.107	0.263	0.241	-	-	0.439	0.485	0.723	0.696	0.631	0.623	0.779	0.610	0.597	0.847	0.606
ProblemAreaID	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	-	-	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	
SolutionTag																	Upgrd;Drop	-	Upgrd	
Trunk or Focus Area ID						TRNK	TRNK						TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK
Engineering Validation Check																				
Engineering Validation Fix					DSI_AB								USI_AB							
expr:US_Cover	2.8	3.5	3.6	3.7	5.2	3.2	2.8	-	3.6	3.0	2.0	2.2	2.8	3.0	3.1	3.4	4.2	4.1	3.4	4.5
expr:DS_Cover	3.4	3.5	3.7	3.7	3.1	2.8	3.7	-	3.0	2.0	2.3	2.5	2.9	3.1	3.4	4.0	4.1	3.2	4.5	2.6
surc	1.00	2.00	2.00	2.00	2.00	2.00	2.00	-	-	2.00	1.00	0.66	0.87	0.89	0.87	1.00	2.00	0.88	1.00	2.00
DS flow (m3/s)	0.01059	0.11562	0.11715	0.11855	0.12073	0.30243	0.26157	-	-	0.53424	0.61472	0.61576	0.61677	0.61768	0.61763	0.61783	0.69707	-	0.69977	0.69987

Node	-	308055	307976	307977	307814	JCT-1262	JCT-1264	-		2090803	2090878	2090880	2090882	308299	308300	308301	307802	307805	307803	305737	-
Node type	-	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-		Manhole	Manhole	Manhole	Manhole	-	Manhole	Manhole	Manhole	-	Manhole	Manhole	-
ground (m AD)	-	346.895	346.500	346.004	345.643	343.190	342.610	343.292		342.355	341.138	341.246	341.430	341.163	340.861	340.709	340.530	340.123	339.146	339.701	-
ProblemAreaID	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7		SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	
SolutionTag																					
Trunk or Focus Area ID						TRNK	TRNK	TRNK						TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK
Engineering Validation Check						-	BNFS;IPD	DNP					IPD								GL_diff
Engineering Validation Fix						-											GL_ELEV				
expr:HGL	-	3.274578	3.513306	3.646212	5.001185	3.168638	2.789993	-		2.934163	1.997131	2.457365	2.865944	-	3.168190	3.466965	3.974458	-	3.421909	4.463512	-

Solution in model:

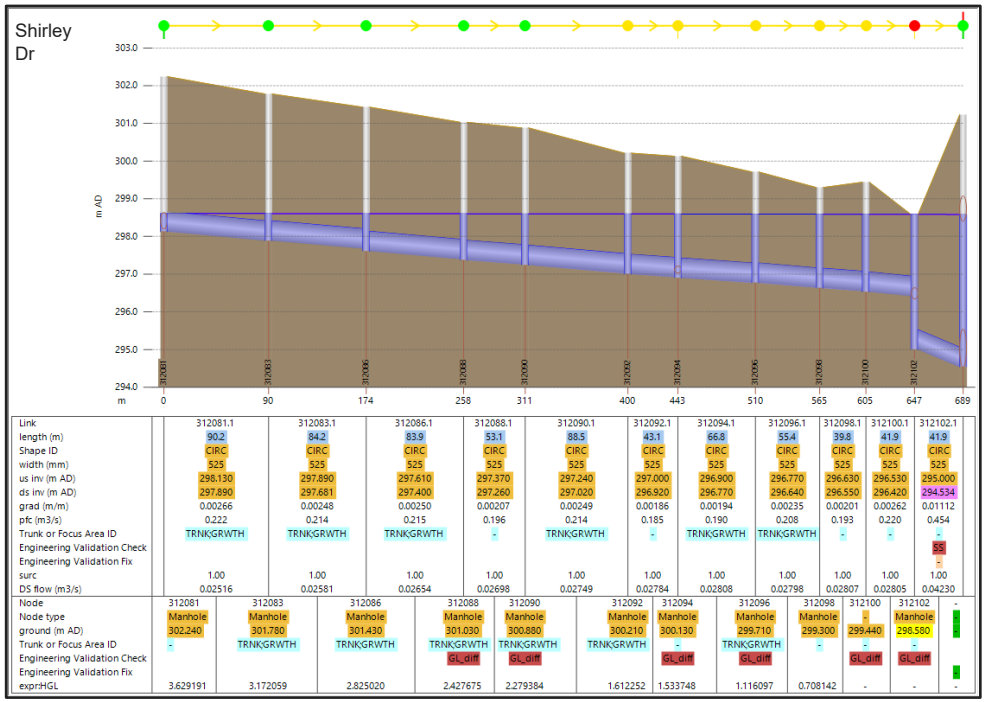
Same solution as the existing scenario.

See note & solution for existing conditions solutions.

TWPAS: Total Wastewater Priority Assessment Score

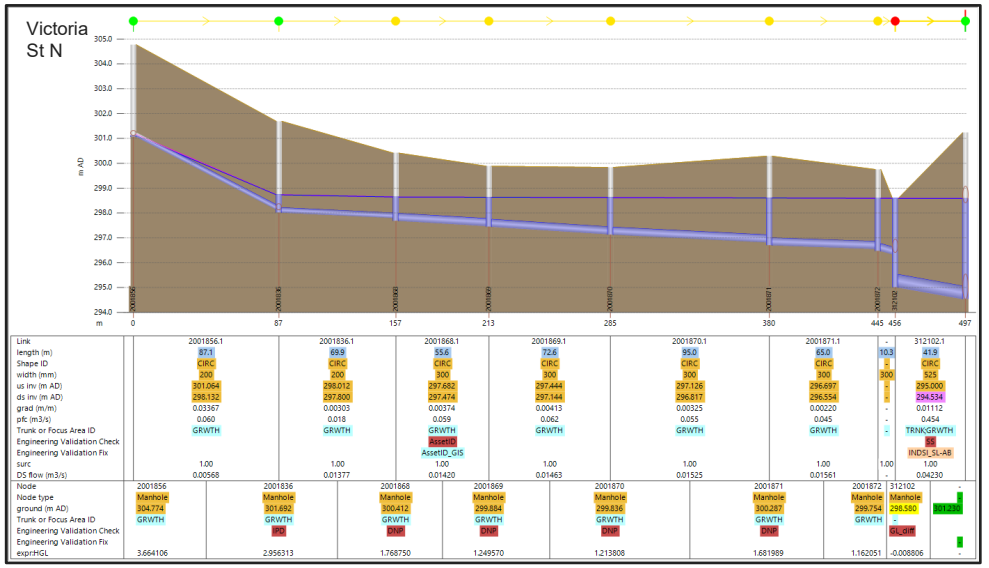
2031 Conditions - 25yr Results - TRUNK

Montgomery – Victoria North
CB-5: Shirley Dr – U/S of Shirley SPS



Link	312081.1	312083.1	312086.1	312088.1	312090.1	312092.1	312094.1	312096.1	312098.1	312100.1	312102.1
length (m)	90.2	84.2	83.9	53.1	88.5	43.1	66.8	55.4	39.8	41.9	41.9
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	525	525	525	525	525	525	525	525	525	525	525
us inv (m AD)	298.130	297.890	297.610	297.370	297.240	297.000	296.900	296.770	296.630	296.530	295.000
ds inv (m AD)	297.890	297.681	297.400	297.260	297.020	296.920	296.770	296.640	296.550	296.420	294.534
grad (m/m)	0.00266	0.00248	0.00250	0.00207	0.00249	0.00186	0.00194	0.00235	0.00201	0.00262	0.01112
pfc (m3/s)	0.222	0.214	0.215	0.196	0.214	0.185	0.190	0.208	0.193	0.220	0.454
Trunk or Focus Area ID	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	-	TRNKGRWTH	-	TRNKGRWTH	TRNKGRWTH	-	-	-
Engineering Validation Check											SS
Engineering Validation Fix											-
surc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DS flow (m3/s)	0.02516	0.02581	0.02654	0.02698	0.02749	0.02784	0.02808	0.02798	0.02807	0.02805	0.04230

Node	312081	312083	312086	312088	312090	312092	312094	312096	312098	312100	312102	-
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-	Manhole	
ground (m AD)	302.240	301.780	301.430	301.030	300.880	300.210	300.130	299.710	299.300	299.440	298.580	
Trunk or Focus Area ID	-	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	-	TRNKGRWTH	-	-	-	
Engineering Validation Check				GL_diff	GL_diff		GL_diff	GL_diff		GL_diff	GL_diff	
Engineering Validation Fix												
exprHGL	3.629191	3.172059	2.825020	2.427675	2.279384	1.612252	1.533748	1.116097	0.708142	-	-	-



Link	2001856.1	2001836.1	2001868.1	2001869.1	2001870.1	2001871.1	-	312102.1
length (m)	87.1	69.9	55.6	72.6	95.0	65.0	10.3	41.9
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	-	CIRC
width (mm)	200	200	300	300	300	300	300	525
us inv (m AD)	301.064	298.012	297.682	297.444	297.126	296.697	-	295.000
ds inv (m AD)	298.132	297.800	297.474	297.144	296.817	296.554	-	294.534
grad (m/m)	0.03367	0.00303	0.00374	0.00413	0.00325	0.00220	-	0.01112
pfc (m3/s)	0.060	0.018	0.059	0.062	0.055	0.045	-	0.454
Trunk or Focus Area ID	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-	TRNKGRWTH
Engineering Validation Check			AssetID					SS
Engineering Validation Fix			AssetID_GIS					INDSI_SL-AB
surc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DS flow (m3/s)	0.00568	0.01377	0.01420	0.01463	0.01525	0.01561	-	0.04230

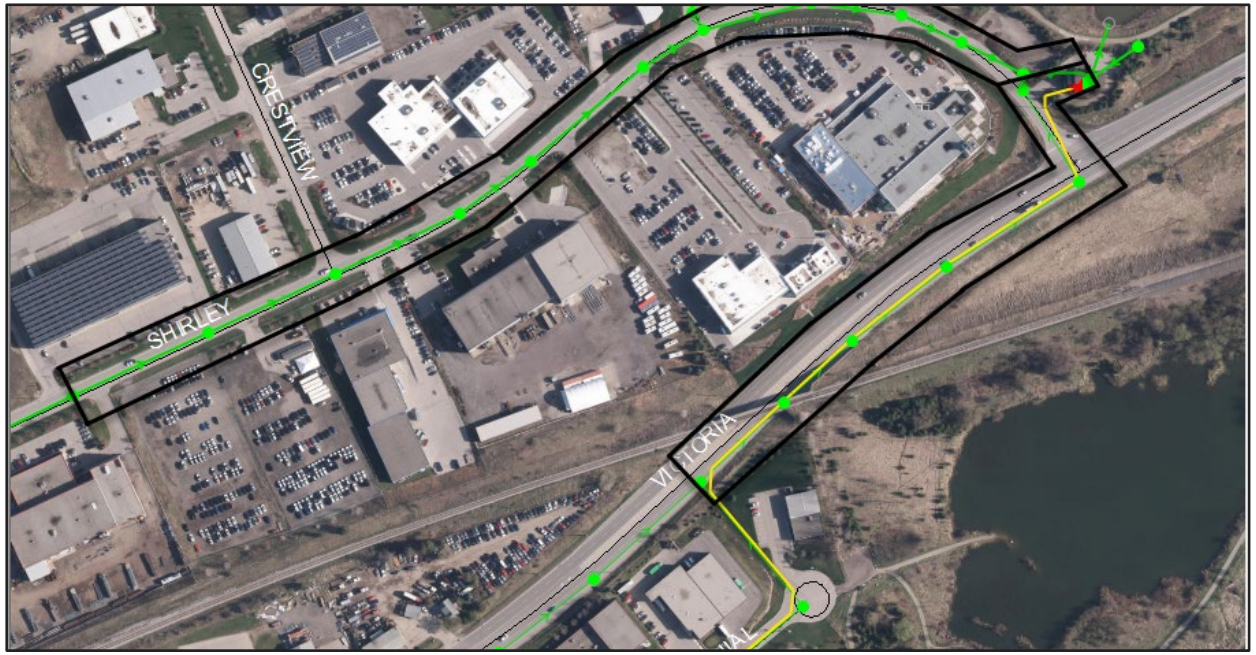
Node	2001856	2001836	2001868	2001869	2001870	2001871	2001872	312102	-
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	
ground (m AD)	304.774	301.692	300.412	299.884	299.836	300.287	298.754	298.580	301.230
Trunk or Focus Area ID	GRWTH	-	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-	
Engineering Validation Check		SD	DNP	DNP	DNP	DNP		GL_diff	
Engineering Validation Fix									
exprHGL	3.664106	2.956313	1.768750	1.249570	1.213808	1.681989	1.162051	-0.008806	-

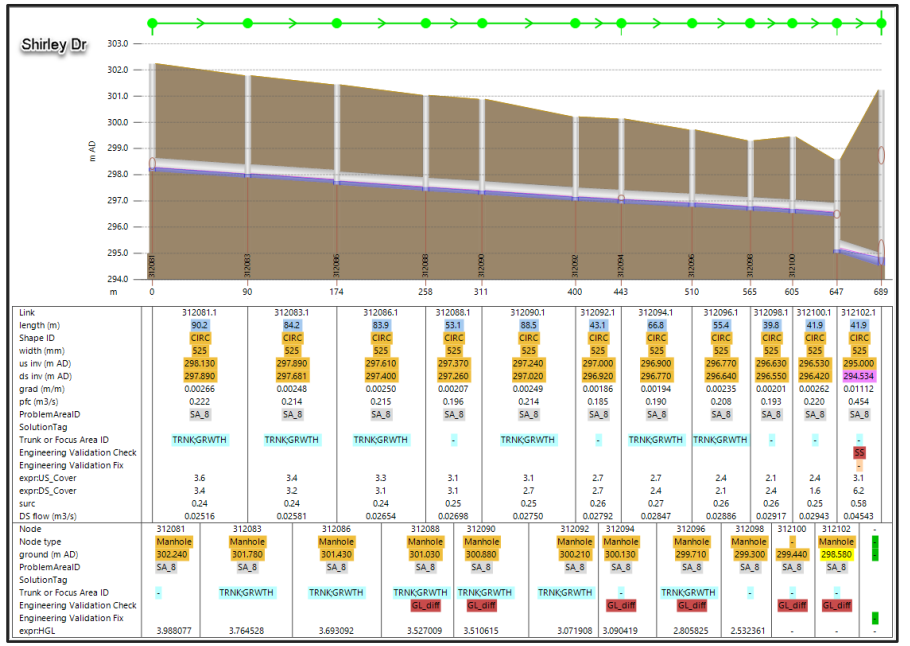
Note:
Same HGL and surcharge issues observed as the existing scenario.
See note & recommendation for existing conditions.

2031 Solution - 25yr Results - TRUNK

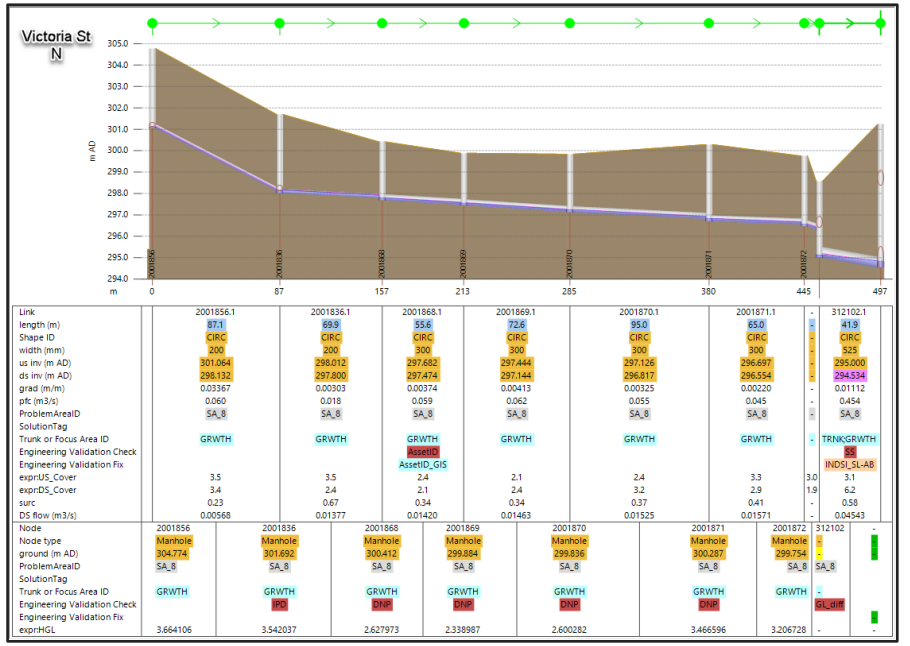
Montgomery – Victoria North

SA-8: Shirley Dr and Victoria St N – U/S of Shirley SPS





Link	312081.1	312083.1	312086.1	312088.1	312090.1	312092.1	312094.1	312096.1	312098.1	312100.1	312102.1
length (m)	90.2	84.2	83.8	53.1	88.5	43.1	66.8	55.4	39.8	41.8	41.9
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	525	525	525	525	525	525	525	525	525	525	525
us inv (m AD)	298.130	297.890	297.610	297.370	297.240	297.000	296.900	296.770	296.630	296.530	295.000
ds inv (m AD)	297.890	297.681	297.400	297.260	297.020	296.920	296.770	296.640	296.550	296.420	294.534
grad (m/m)	0.00266	0.00248	0.00250	0.00207	0.00249	0.00186	0.00194	0.00235	0.00201	0.00262	0.01112
pfc (m3/s)	0.222	0.214	0.215	0.196	0.214	0.185	0.190	0.208	0.193	0.220	0.454
ProblemAreaID	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8
SolutionTag											
Trunk or Focus Area ID	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	-	TRNKGRWTH	-	TRNKGRWTH	TRNKGRWTH	-	-	-
Engineering Validation Check											SS
Engineering Validation Fix											-
exprUS_Cover	3.6	3.4	3.3	3.1	3.1	2.7	2.7	2.4	2.1	2.4	3.1
exprDS_Cover	3.4	3.2	3.1	3.1	2.7	2.7	2.4	2.1	2.4	1.6	6.2
surc	0.24	0.24	0.24	0.25	0.25	0.26	0.27	0.26	0.26	0.25	0.58
DS flow (m3/s)	0.02516	0.02581	0.02654	0.02698	0.02750	0.02792	0.02847	0.02886	0.02917	0.02943	0.04543
Node	312081	312083	312086	312088	312090	312092	312094	312096	312098	312100	312102	-
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-	Manhole	
ground (m AD)	302.240	301.780	301.430	301.030	300.880	300.210	300.130	299.710	299.300	299.440	298.580	
ProblemAreaID	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	
SolutionTag												
Trunk or Focus Area ID	-	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	-	TRNKGRWTH	-	-	-	
Engineering Validation Check				GL_diff	GL_diff		GL_diff	GL_diff		GL_diff	GL_diff	
Engineering Validation Fix												
exprHGL	3.988077	3.764528	3.693092	3.527009	3.510615	3.071908	3.090419	2.805825	2.532361	-	-	-



Link	2001856.1	2001836.1	2001868.1	2001869.1	2001870.1	2001871.1	-	312102.1
length (m)	87.1	69.9	55.6	72.6	95.0	65.0	-	41.9
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	-	CIRC
width (mm)	200	200	300	300	300	300	-	525
us inv (m AD)	301.064	298.012	297.682	297.444	297.126	296.697	-	295.000
ds inv (m AD)	298.132	297.800	297.474	297.144	296.817	296.554	-	294.534
grad (m/m)	0.03367	0.00303	0.00374	0.00413	0.00325	0.00220	-	0.01112
pfc (m3/s)	0.060	0.018	0.059	0.062	0.055	0.045	-	0.454
ProblemAreaID	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	-	SA_8
SolutionTag								
Trunk or Focus Area ID	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-	TRNKGRWTH
Engineering Validation Check			AssetID					SS
Engineering Validation Fix			AssetID_GIS					INDSI_SL-AB
exprUS_Cover	3.5	3.5	2.4	2.1	2.4	3.3	3.0	3.1
exprDS_Cover	3.4	2.4	2.1	2.4	3.2	2.9	1.9	6.2
surc	0.23	0.67	0.34	0.34	0.37	0.41	-	0.58
DS flow (m3/s)	0.00568	0.01377	0.01420	0.01463	0.01525	0.01571	-	0.04543
Node	2001856	2001836	2001868	2001869	2001870	2001871	2001872	312102	-
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-	
ground (m AD)	304.774	301.692	300.412	299.884	299.836	300.287	299.754	-	
ProblemAreaID	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	
SolutionTag									
Trunk or Focus Area ID	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-	
Engineering Validation Check		IPD	DNP	DNP	DNP	DNP		GL_diff	
Engineering Validation Fix									
exprHGL	3.664106	3.542037	2.627973	2.338987	2.600282	3.466596	3.206728	-	-

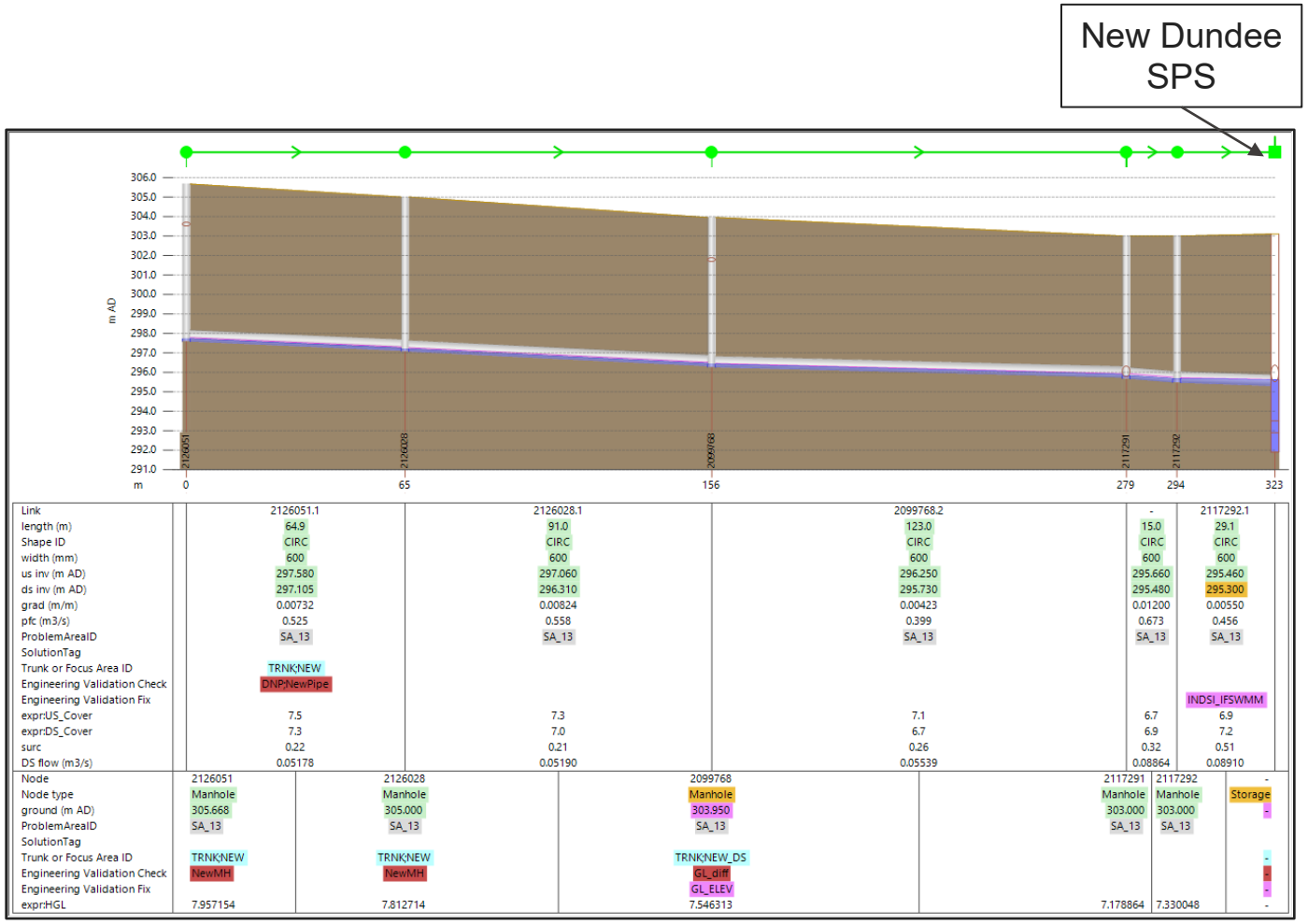
Solution in model:

Same solution as the existing scenario.

See note & solution for existing conditions solutions.

2031 Conditions Solutions - 25yr Results - TRUNK

SA-13: New Dundee SPS



Link	2126051.1	2126028.1	2099768.2	-	2117292.1
length (m)	64.9	91.0	123.0	15.0	29.1
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	600	600	600	600	600
us inv (m AD)	297.580	297.060	296.250	295.660	295.460
ds inv (m AD)	297.105	296.310	295.730	295.480	295.300
grad (m/m)	0.00732	0.00824	0.00423	0.01200	0.00550
pfc (m3/s)	0.525	0.558	0.399	0.673	0.456
ProblemAreaID	SA_13	SA_13	SA_13	SA_13	SA_13
SolutionTag					
Trunk or Focus Area ID	TRNK;NEW				
Engineering Validation Check	DNP;NewPipe				
Engineering Validation Fix					INDSI_IFSWMM
expr:US_Cover	7.5	7.3	7.1	6.7	6.9
expr:DS_Cover	7.3	7.0	6.7	6.9	7.2
surc	0.22	0.21	0.26	0.32	0.51
DS flow (m3/s)	0.05178	0.05190	0.05539	0.08864	0.08910

Node	2126051	2126028	2099768	2117291	2117292	-
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Storage
ground (m AD)	305.668	305.000	303.950	303.000	303.000	-
ProblemAreaID	SA_13	SA_13	SA_13	SA_13	SA_13	
SolutionTag						
Trunk or Focus Area ID	TRNK;NEW	TRNK;NEW	TRNK;NEW_DS			-
Engineering Validation Check	NewMH	NewMH	GL_diff			-
Engineering Validation Fix			GL_ELEV			-
expr:HGL	7.957154	7.812714	7.546313	7.178864	7.330048	-

Note:

Significant new development (2,337 people) for 2031.

The growth areas are connected to Dodge Dr based on the Growth Management Plan.

The 10yr peak flow is higher than the firm capacity of New Dundee SPS.

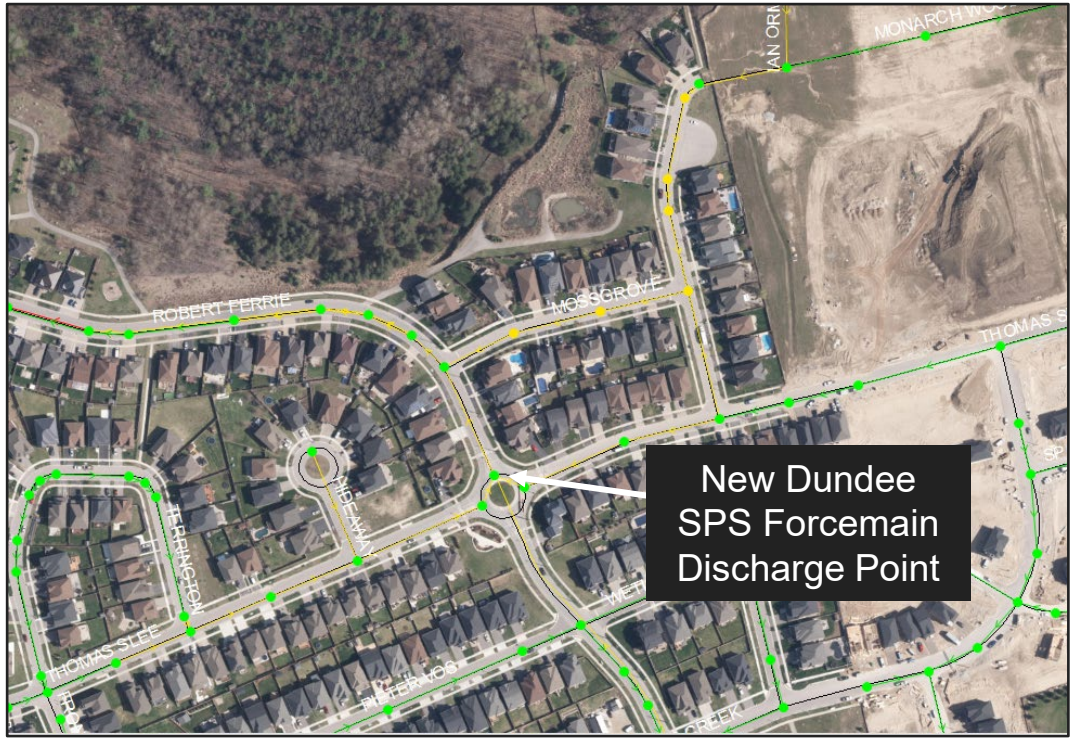
Solution in model:

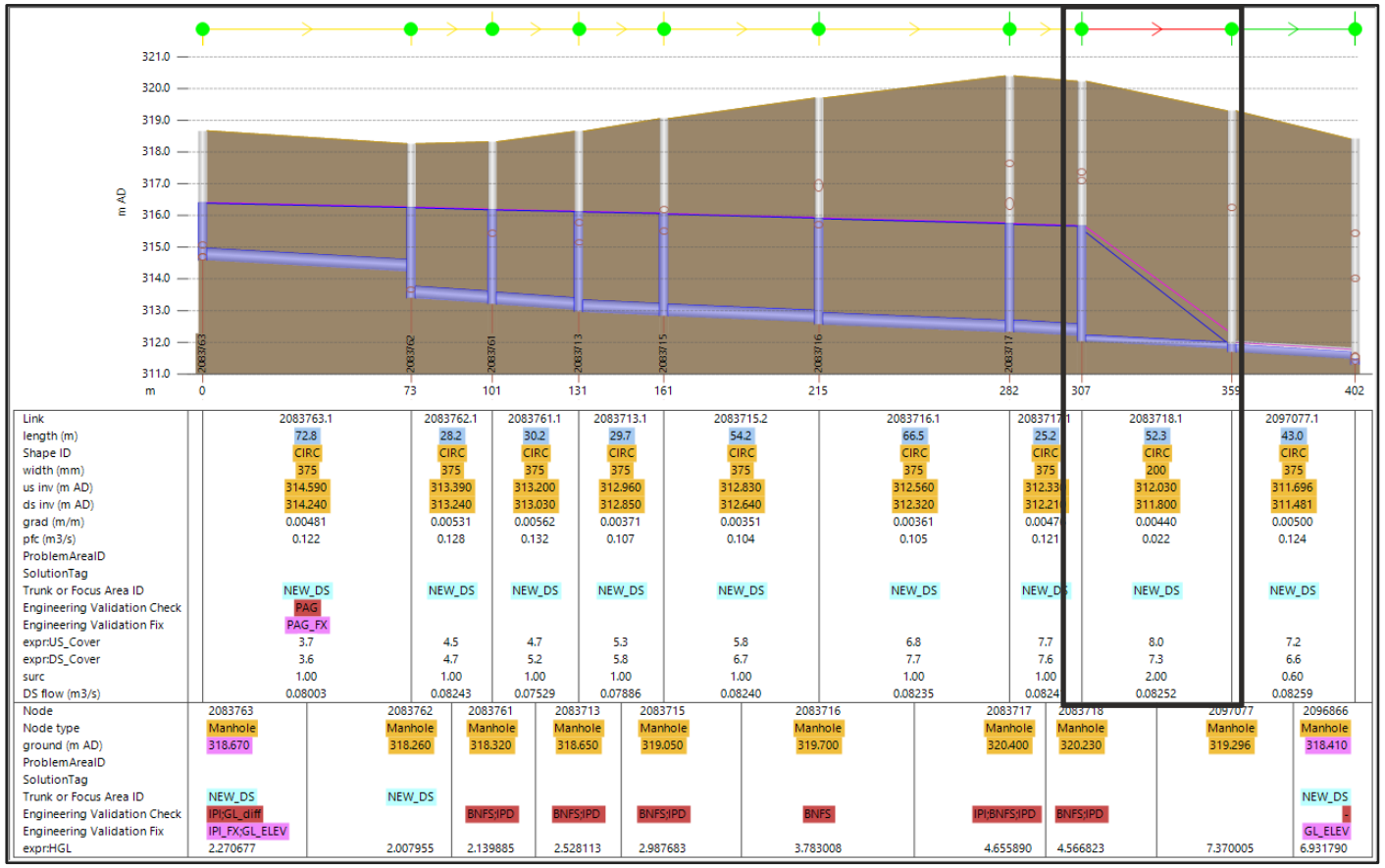
Upgrade New Dundee SPS capacity to 75 L/s (based on 2051 10yr peak flow).

2031 Conditions Solutions - 25yr Results - LOCAL

Robert Ferrie

CB-7: Downstream of New Dundee SPS





Link	2083763.1	2083762.1	2083761.1	2083713.1	2083715.2	2083716.1	2083717.1	2083718.1	2097077.1
length (m)	72.8	28.2	30.2	29.7	54.2	66.5	25.2	52.3	43.0
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	375	375	375	375	375	375	375	200	375
us inv (m AD)	314.590	313.390	313.200	312.960	312.830	312.560	312.33	312.030	311.696
ds inv (m AD)	314.240	313.240	313.030	312.850	312.640	312.320	312.21	311.800	311.481
grad (m/m)	0.00481	0.00531	0.00562	0.00371	0.00351	0.00361	0.0047	0.00440	0.00500
pfc (m3/s)	0.122	0.128	0.132	0.107	0.104	0.105	0.121	0.022	0.124
ProblemAreaID									
SolutionTag									
Trunk or Focus Area ID	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS
Engineering Validation Check	PAG								
Engineering Validation Fix	PAG_FX								
expr:US_Cover	3.7	4.5	4.7	5.3	5.8	6.8	7.7	8.0	7.2
expr:DS_Cover	3.6	4.7	5.2	5.8	6.7	7.7	7.6	7.3	6.6
surc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	0.60
DS flow (m3/s)	0.08003	0.08243	0.07529	0.07886	0.08240	0.08235	0.0824	0.08252	0.08259

Node	2083763	2083762	2083761	2083713	2083715	2083716	2083717	2083718	2097077	2096866
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole
ground (m AD)	318.670	318.260	318.320	318.650	319.050	319.700	320.400	320.230	319.296	318.410
ProblemAreaID										
SolutionTag										
Trunk or Focus Area ID	NEW_DS	NEW_DS								NEW_DS
Engineering Validation Check	IPI;GL_diff		BNFS;IPD	BNFS;IPD	BNFS;IPD	BNFS	IPI;BNFS;IPD	BNFS;IPD		-
Engineering Validation Fix	IPI_FX;GL_ELEV									GL_ELEV
expr:HGL	2.270677	2.007955	2.139885	2.528113	2.987683	3.783008	4.655890	4.566823	7.370005	6.931790

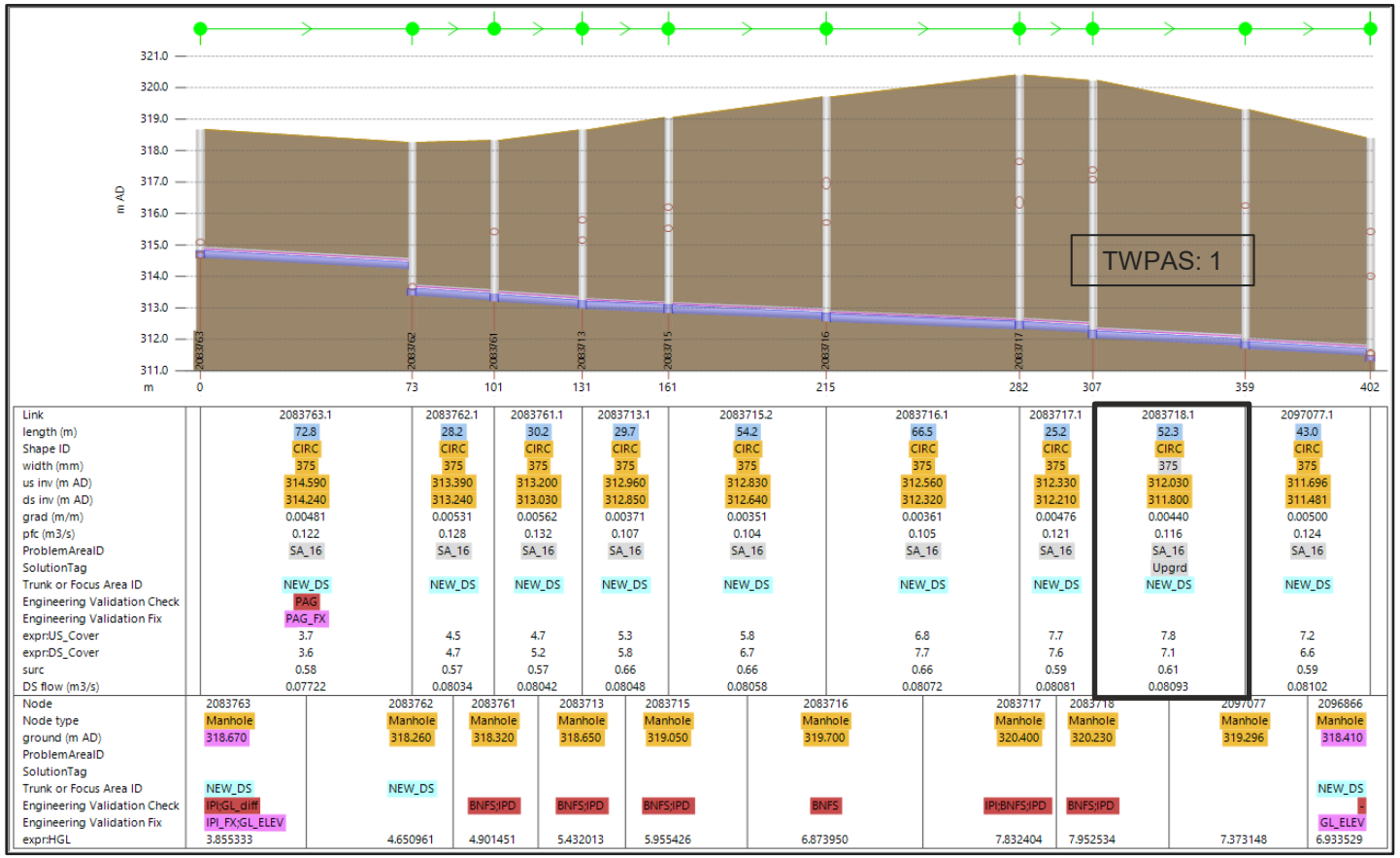
Note:

The New Dundee SPS capacity upgrades (75 L/s or 94 L/s) creates HGL and surcharge issues D/S of the forcemain due to an undersized D/S pipe.

2031 Conditions Solutions - 25yr Results - LOCAL

Robert Ferrie

SA-16: Downstream of New Dundee SPS



Link	2083763.1	2083762.1	2083761.1	2083713.1	2083715.2	2083716.1	2083717.1	2083718.1	2097077.1
length (m)	72.8	28.2	30.2	29.7	54.2	66.5	25.2	52.3	43.0
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	375	375	375	375	375	375	375	375	375
us inv (m AD)	314.590	313.390	313.200	312.960	312.830	312.560	312.330	312.030	311.696
ds inv (m AD)	314.240	313.240	313.030	312.850	312.640	312.320	312.210	311.800	311.481
grad (m/m)	0.00481	0.00531	0.00562	0.00371	0.00351	0.00361	0.00476	0.00440	0.00500
pfc (m3/s)	0.122	0.128	0.132	0.107	0.104	0.105	0.121	0.116	0.124
ProblemAreaID	SA_16	SA_16	SA_16	SA_16	SA_16	SA_16	SA_16	SA_16	SA_16
SolutionTag								Upgrd	
Trunk or Focus Area ID	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS
Engineering Validation Check	PAG								
Engineering Validation Fix	PAG_FX								
expr:US_Cover	3.7	4.5	4.7	5.3	5.8	6.8	7.7	7.8	7.2
expr:DS_Cover	3.6	4.7	5.2	5.8	6.7	7.7	7.6	7.1	6.6
surc	0.58	0.57	0.57	0.66	0.66	0.66	0.59	0.61	0.59
DS flow (m3/s)	0.07722	0.08034	0.08042	0.08048	0.08058	0.08072	0.08081	0.08093	0.08102

Node	2083763	2083762	2083761	2083713	2083715	2083716	2083717	2083718	2097077	2096866
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole
ground (m AD)	318.670	318.260	318.320	318.650	319.050	319.700	320.400	320.230	319.296	318.410
ProblemAreaID										
SolutionTag										
Trunk or Focus Area ID	NEW_DS	NEW_DS								NEW_DS
Engineering Validation Check	IPI;GL_diff		BNFS;IPD	BNFS;IPD	BNFS;IPD	BNFS	IPI;BNFS;IPD	BNFS;IPD		-
Engineering Validation Fix	IPI_FX;GL_ELEV									GL_ELEV
expr:HGL	3.855333	4.650961	4.901451	5.432013	5.955426	6.873950	7.832404	7.952534	7.373148	6.933529

Note:

Stantec completed the Doon South Pumping Station Review of Preferred Forcemain Configuration for Ultimate Design (Stantec, 2019) that accounted for ultimate conditions (178 L/s pump station capacity, as per the Doon South Sanitary Pumping Station Confirmation of Design Flows Technical Memorandum by MMM Group, 2014). The Forcemain Configuration report investigated the upgrade and extension of the forcemain to the Homer Watson SPS.

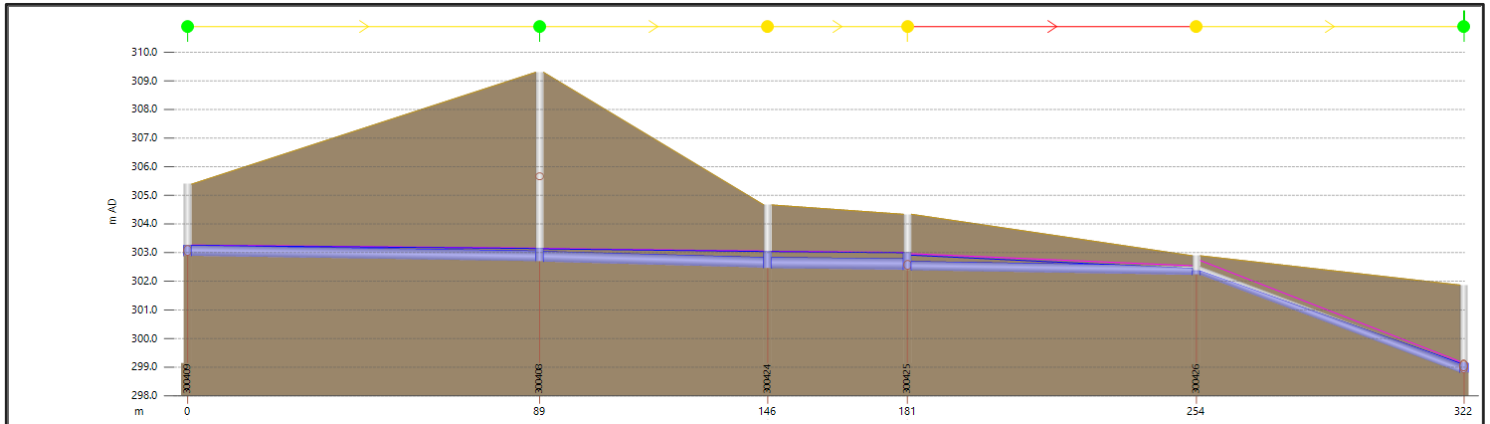
Solution in model:

Upgraded 1 pipe from 200 mm to 375 mm.

TWPAS: Total Wastewater Priority Assessment Score

2051 Conditions - 25yr Results - LOCAL

Montgomery – Freeport
CB-1: U/S of King St SPS

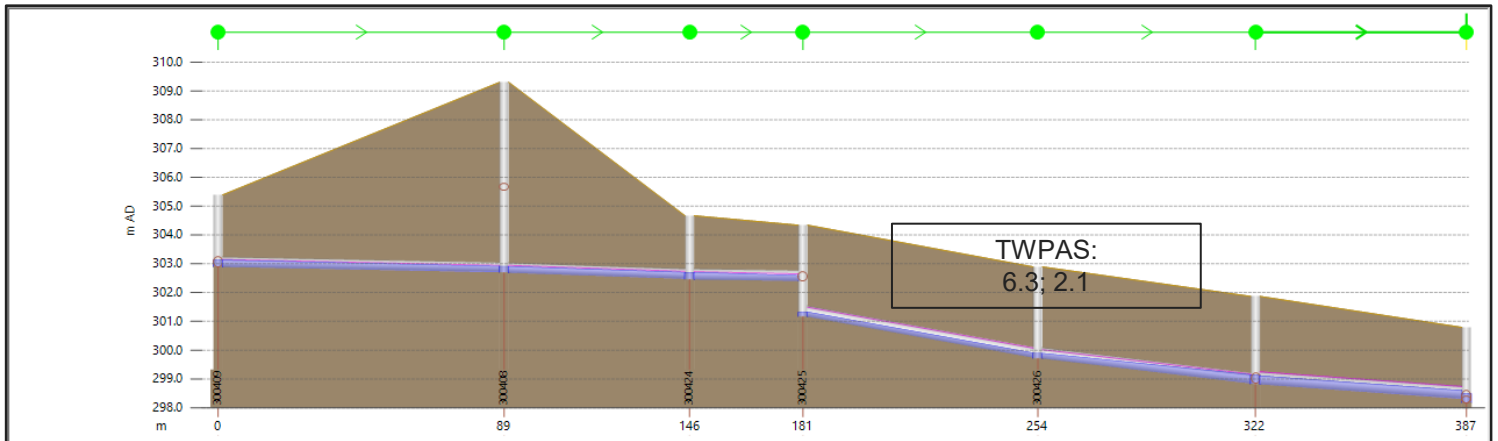


Link		300409.1		300408.1		300424.1		300425.1		300426.1	
length (m)		88.7		57.5		35.2		72.9		67.5	
Shape ID		CIRC		CIRC		CIRC		CIRC		CIRC	
width (mm)		350		350		375		300		300	
us inv (m AD)		302.892		302.688		302.456		302.389		302.229	
ds inv (m AD)		302.706		302.480		302.407		302.229		298.817	
grad (m/m)		0.00210		0.00362		0.00139		0.00220		0.05056	
pfc (m3/s)		0.067		0.088		0.065		0.045		0.217	
ProblemAreaID		AC		AC		SA_1		AC		AC	
SolutionTag		MONTGOMERY - FREEPORT		MONTGOMERY - FREEPORT				MONTGOMERY - FREEPORT		MONTGOMERY - FREEPORT	
Trunk or Focus Area ID								GRWTH_DS		GRWTH_DS	
Engineering Validation Check						SS		PAG		SS	
Engineering Validation Fix						DSI_AB		PAG_FX			
surc		1.00		1.00		1.00		2.00		1.00	
DS flow (m3/s)		0.04990		0.05732		0.05764		0.07566		0.07594	
Node	300409		300408		300424		300425		300426		300427
Node type	Manhole		Manhole		Manhole		Manhole		Manhole		Manhole
ground (m AD)	305.392		309.298		304.666		304.340		302.890		301.867
User text 1											
User text 2											
Trunk or Focus Area ID							GRWTH_DS		GRWTH_DS		TRNK;GRWTH_DS
Engineering Validation Check							IPIPDSGL_diff				
Engineering Validation Fix							GL_ELEV		GL_ELEV		
exprHGL	2.139772		6.153347		1.625564		1.345096		0.534409		2.730098

Note:
Same HGL and surcharge issues observed as the existing and 2031 scenarios.
See note & recommendation for existing conditions.

2051 Conditions Solutions - 25yr Results - LOCAL

Montgomery – Freeport
SA_1: U/S of King St SPS



Link		300409.1		300408.1		300424.1		300425.1		300426.1		300427.1	
length (m)		88.7		57.5		35.2		72.9		67.5		65.5	
Shape ID		CIRC		CIRC		CIRC		CIRC		CIRC		CIRC	
width (mm)		350		350		375		375		375		450	
us inv (m AD)		302.892		302.688		302.456		301.165		299.715		298.817	
ds inv (m AD)		302.706		302.480		302.407		299.745		298.847		298.311	
grad (m/m)		0.00210		0.00362		0.00139		0.01949		0.01286		0.00773	
pfc (m3/s)		0.067		0.088		0.065		0.245		0.199		0.251	
ProblemAreaID		SA_1		SA_1		SA_1		SA_1		SA_1		SA_1	
SolutionTag								Upgrd;Drop		Upgrd;Drop			
Trunk or Focus Area ID								GRWTH_DS		GRWTH_DS		TRNK;GRWTH_DS	
Engineering Validation Check						SS		PAG		SS			
Engineering Validation Fix						DSI_AB		PAG_FX					
expr:US_Cover		2.1		6.3		1.8		2.8		2.8		2.6	
expr:DS_Cover		6.2		1.8		1.6		2.8		2.6		2.0	
surc		0.65		0.61		0.63		0.40		0.77		0.62	
DS flow (m3/s)		0.05016		0.05766		0.05798		0.07614		0.07642		0.17726	
Node	300409		300408		300424		300425		300426		300427		300428
Node type	Manhole		Manhole		Manhole		Manhole		Manhole		Manhole		Manhole
ground (m AD)	305.392		309.298		304.666		304.340		302.890		301.867		300.791
ProblemAreaID	SA_1		SA_1		SA_1		SA_1		SA_1		SA_1		SA_1
SolutionTag													
Trunk or Focus Area ID							GRWTH_DS		GRWTH_DS		TRNK;GRWTH_DS		-
Engineering Validation Check							IPI;IPD;GL_diff						IPI;DNP;GL_diff
Engineering Validation Fix							GL_ELEV		GL_ELEV				IPI_FX
expr:HGL	2.272981		6.397548		1.973556		3.024814		3.008622		2.730007		2.300613

<u>Solution in model:</u>

Same solution as the existing and 2031 scenario.

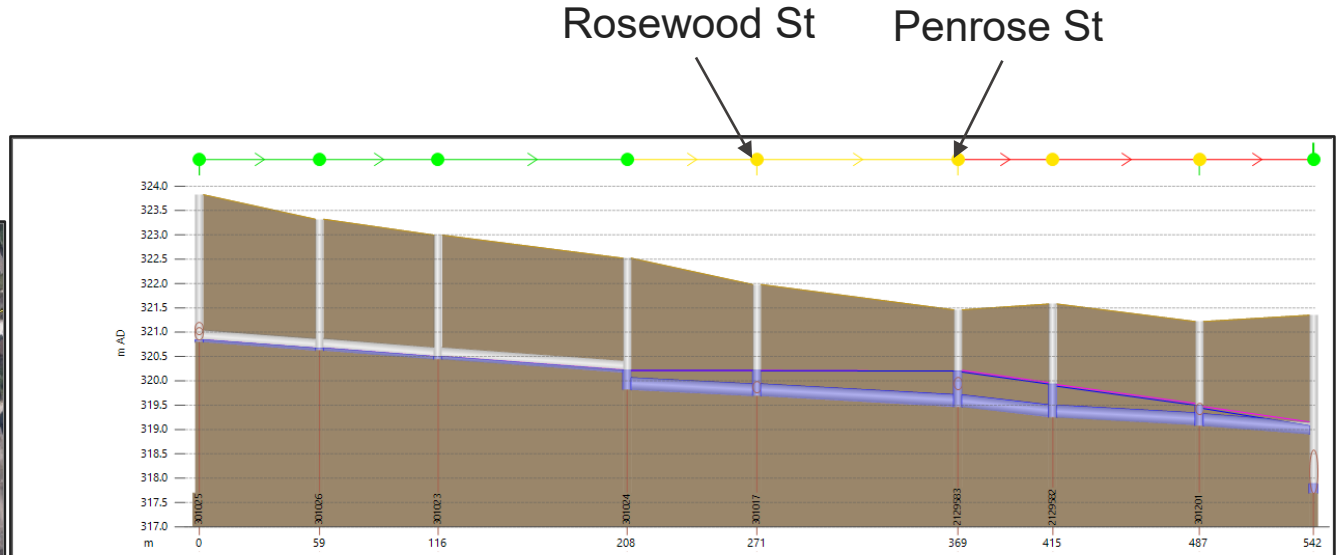
See note & solution for existing conditions solutions.

TWPAS: Total Wastewater Priority Assessment Score

2051 Conditions - 25yr Results - LOCAL

Montgomery – Manchester Direct

CB-2: Dalewood Dr



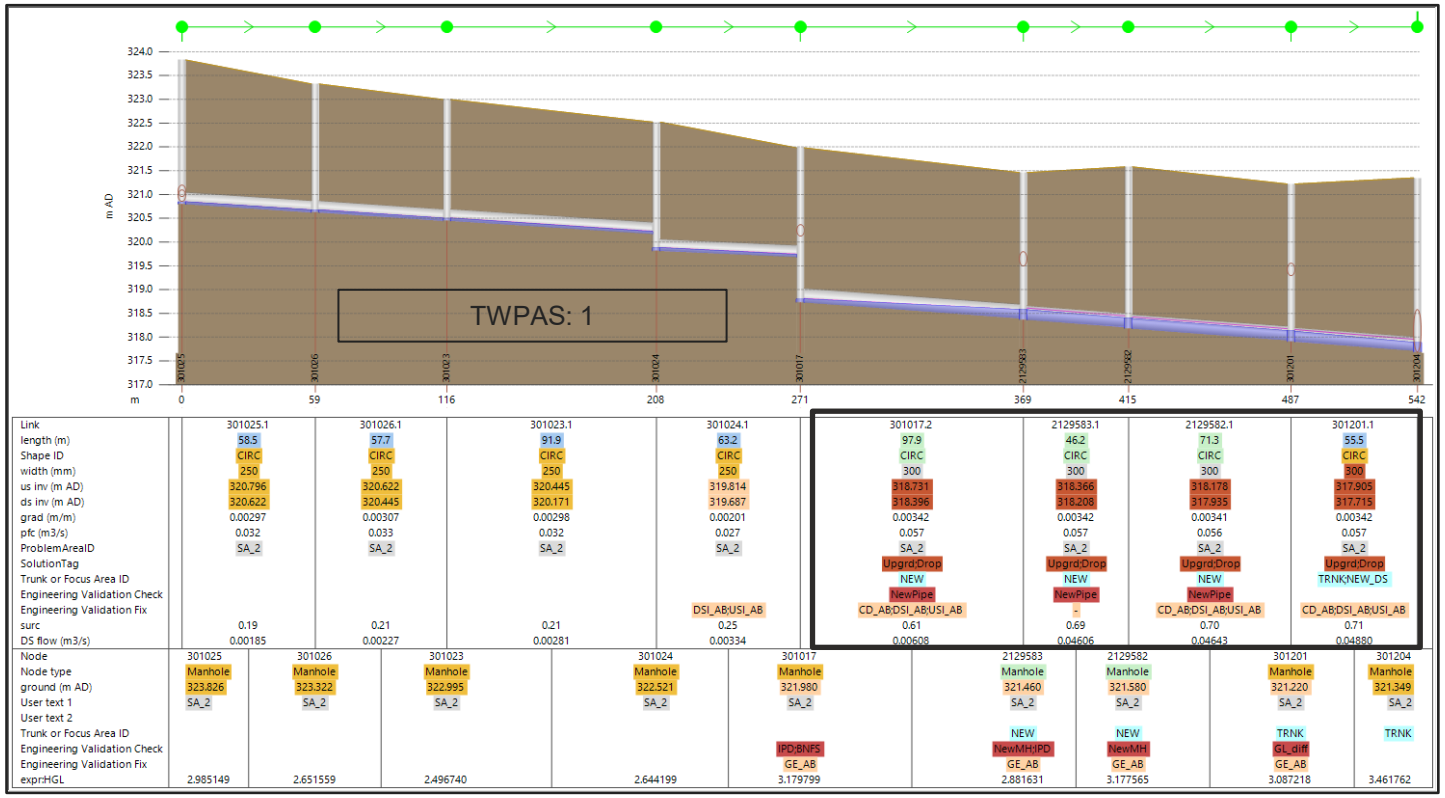
Link	301025.1	301026.1	301023.1	301024.1	301017.2	2129583.1	2129582.1	301201.1
length (m)	58.5	57.7	91.9	63.2	97.9	46.2	71.3	55.5
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	250	250	250	250	250	250	250
us inv (m AD)	320.796	320.622	320.445	319.814	319.687	319.462	319.249	319.072
ds inv (m AD)	320.622	320.445	320.171	319.687	319.467	319.256	319.092	318.902
grad (m/m)	0.00297	0.00307	0.00298	0.00201	0.00225	0.00446	0.00220	0.00306
pfc (m3/s)	0.032	0.033	0.032	0.027	0.028	0.040	0.028	0.033
ProblemAreaID	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2
SolutionTag								
Trunk or Focus Area ID					NEW	NEW	NEW	TRNK;NEW_DS
Engineering Validation Check					NewPipe	NewPipe	NewPipe	
Engineering Validation Fix				DSI_AB;USI_AB	CD_AB;DSI_AB;USI_AB	-	CD_AB;DSI_AB;USI_AB	-
surc	0.19	0.21	0.21	1.00	1.00	2.00	2.00	2.00
DS flow (m3/s)	0.00185	0.00227	0.00281	0.00361	0.00616	0.04307	0.04344	0.04578

Node	301025	301026	301023	301024	301017	2129583	2129582	301201	301204
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-
ground (m AD)	323.826	323.322	322.995	322.521	321.980	321.460	321.580	321.220	321.349
ProblemAreaID	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2
SolutionTag									
Trunk or Focus Area ID						NEW	NEW	TRNK	TRNK
Engineering Validation Check					IPD;BNFS	NewMH;IPD	NewMH	GL_diff	
Engineering Validation Fix					GE_AB	GE_AB	GE_AB	GE_AB	
expr:HGL	2.985149	2.651559	2.496740	2.306492	1.767872	1.259652	1.650221	1.726927	-

Note:
Same HGL and surcharge issues observed as the existing and 2031 scenarios.
See note & recommendation for existing conditions.

2051 Conditions Solutions - 25yr Results - LOCAL

Montgomery – Manchester Direct
SA-2: Dalewood Dr



Link	301025.1	301026.1	301023.1	301024.1	301017.2	2129583.1	2129582.1	301201.1
length (m)	58.5	57.7	91.9	63.2	97.9	46.2	71.3	55.5
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	250	250	250	300	300	300	300
us inv (m AD)	320.796	320.622	320.445	319.814	318.731	318.366	318.178	317.905
ds inv (m AD)	320.622	320.445	320.171	319.687	318.396	318.208	317.935	317.715
grad (m/m)	0.00297	0.00307	0.00298	0.00201	0.00342	0.00342	0.00341	0.00342
pfc (m3/s)	0.032	0.033	0.032	0.027	0.057	0.057	0.056	0.057
ProblemAreaID	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2
SolutionTag					Upgrd:Drop	Upgrd:Drop	Upgrd:Drop	Upgrd:Drop
Trunk or Focus Area ID					NEW	NEW	NEW	TRNK;NEW_DS
Engineering Validation Check					NewPipe	NewPipe	NewPipe	
Engineering Validation Fix				DSI_AB;USI_AB	CD_AB;DSI_AB;USI_AB	-	CD_AB;DSI_AB;USI_AB	CD_AB;DSI_AB;USI_AB
surc	0.19	0.21	0.21	0.25	0.61	0.69	0.70	0.71
DS flow (m3/s)	0.00185	0.00227	0.00281	0.00334	0.00608	0.04606	0.04643	0.04880

Node	301025	301026	301023	301024	301017	2129583	2129582	301201	301204
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole
ground (m AD)	323.826	323.322	322.995	322.521	321.980	321.460	321.580	321.220	321.349
User text 1	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2	SA_2
User text 2									
Trunk or Focus Area ID						NEW	NEW	TRNK	TRNK
Engineering Validation Check					IPD;BNFS	NewMH;IPD	NewMH	GL_diff	
Engineering Validation Fix					GE_AB	GE_AB	GE_AB	GE_AB	
exprHGL	2.985149	2.651559	2.496740	2.644199	3.179799	2.881631	3.177565	3.087218	3.461762

<u>Solution in model:</u>

Same solution as the existing and 2031 scenario.

See note & solution for existing conditions solutions.

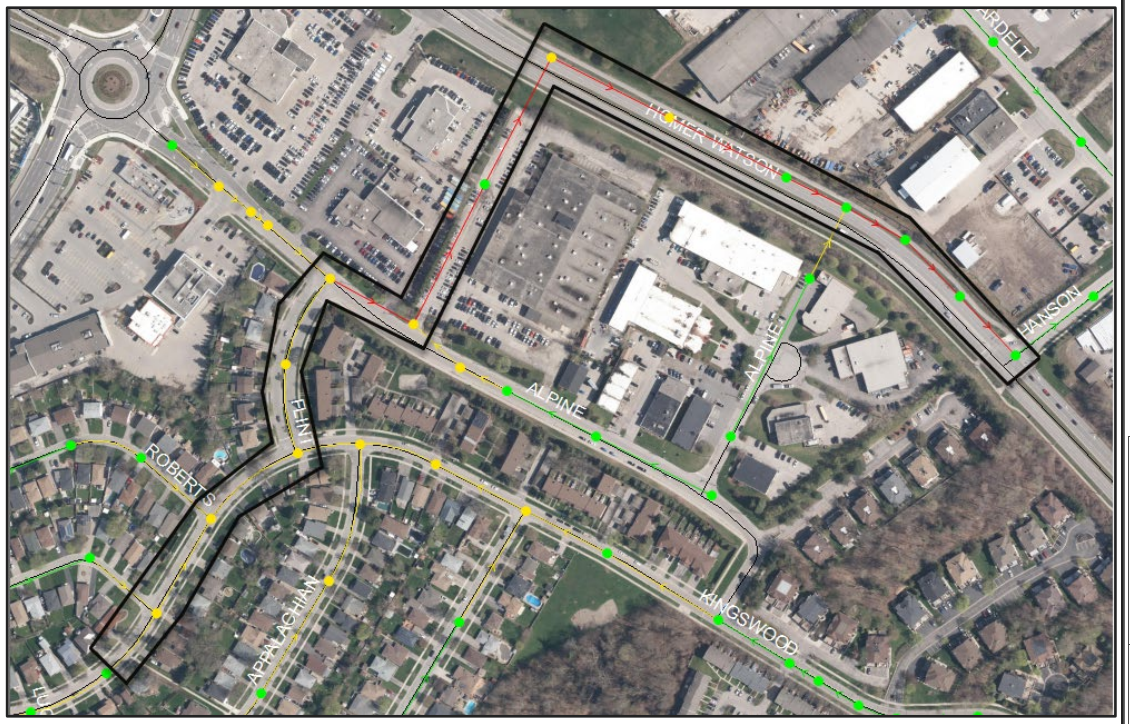
TWPAS: Total Wastewater Priority Assessment Score

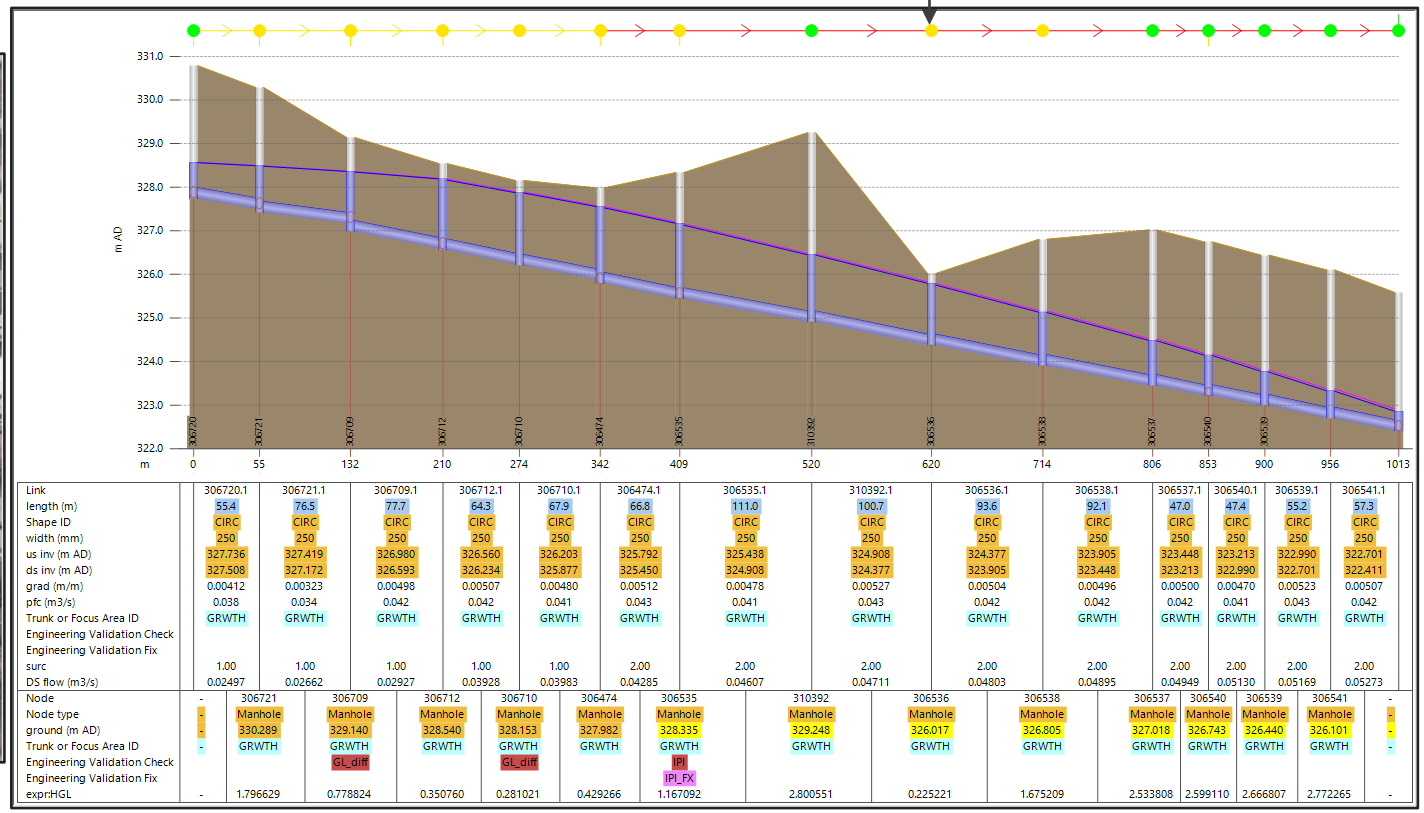
2051 Conditions - 25yr Results – LOCAL

Upper Schneider Direct - near Ottawa St S

CB-3: Homer Watson Blvd

DEM: 326.77 m
GIS: 326.014 m
Model: 326.017 m





Link	306720.1	306721.1	306709.1	306712.1	306710.1	306474.1	306535.1	310392.1	306536.1	306538.1	306537.1	306540.1	306539.1	306541.1
length (m)	55.4	76.5	77.7	64.3	67.9	66.8	111.0	100.7	93.6	92.1	47.0	47.4	55.2	57.3
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	250	250	250	250	250	250	250	250	250	250	250	250	250
us inv (m AD)	327.736	327.419	326.980	326.560	326.203	325.792	325.438	324.908	324.377	323.905	323.448	323.213	322.990	322.701
ds inv (m AD)	327.508	327.172	326.593	326.234	325.877	325.450	324.908	324.377	323.905	323.448	323.213	322.990	322.701	322.411
grad (m/m)	0.00412	0.00323	0.00498	0.00507	0.00480	0.00512	0.00478	0.00527	0.00504	0.00496	0.00500	0.00470	0.00523	0.00507
pfc (m3/s)	0.038	0.034	0.042	0.042	0.041	0.043	0.041	0.043	0.042	0.042	0.042	0.041	0.043	0.042
Trunk or Focus Area ID	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH
Engineering Validation Check														
Engineering Validation Fix														
surc	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
DS flow (m3/s)	0.02497	0.02662	0.02927	0.03928	0.03983	0.04285	0.04607	0.04711	0.04803	0.04895	0.04949	0.05130	0.05169	0.05273
Node	-	306721	306709	306712	306710	306474	306535	310392	306536	306538	306537	306540	306539	306541	-
Node type	-	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-
ground (m AD)	-	330.289	329.140	328.540	328.153	327.982	328.335	329.248	326.017	326.805	327.018	326.743	326.440	326.101	-
Trunk or Focus Area ID	-	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-
Engineering Validation Check			GL_diff		GL_diff		PI								
Engineering Validation Fix							IPI_FX								
expr:HGL	-	1.796629	0.778824	0.350760	0.281021	0.429266	1.167092	2.800551	0.225221	1.675209	2.533808	2.599110	2.666807	2.772265	-

Note:
More HGL and surcharge issues observed in the 2051 scenario than in the existing and 2031 scenarios.

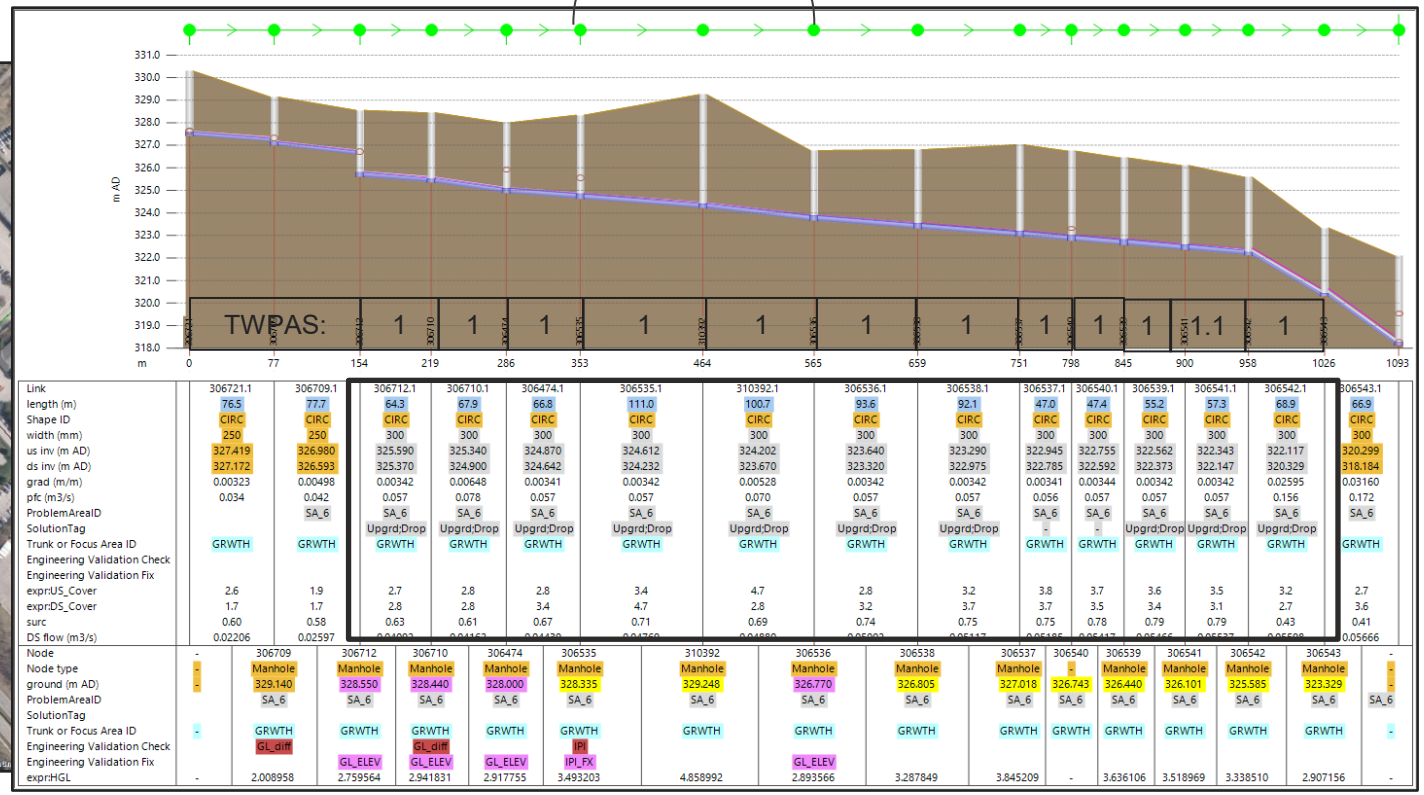
Recommendation:
Upgrade the pipes; potentially providing inline storage upstream of pipes in private property.

2051 Conditions Solutions – ALTERNATIVE A - 25yr Results – LOCAL

Upper Schneider Direct - near Ottawa St S

SA-6: Homer Watson Blvd

Private property



Link	306721.1	306709.1	306712.1	306710.1	306474.1	306535.1	310392.1	306536.1	306538.1	306537.1	306540.1	306539.1	306541.1	306542.1	306543.1
length (m)	76.5	77.7	64.3	67.9	66.8	111.0	100.7	93.6	92.1	47.0	47.4	55.2	57.3	68.9	66.9
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	250	300	300	300	300	300	300	300	300	300	300	300	300	300
us inv (m AD)	327.419	326.980	325.590	325.340	324.870	324.612	324.202	323.640	323.290	322.945	322.755	322.562	322.343	322.117	320.299
ds inv (m AD)	327.172	326.593	325.370	324.900	324.642	324.232	323.670	323.320	322.975	322.785	322.592	322.373	322.147	320.329	318.184
grad (m/m)	0.00323	0.00498	0.00342	0.00648	0.00341	0.00342	0.00528	0.00342	0.00342	0.00341	0.00344	0.00342	0.00342	0.02595	0.03160
pfc (m3/s)	0.034	0.042	0.057	0.078	0.057	0.057	0.070	0.057	0.057	0.056	0.057	0.057	0.057	0.156	0.172
ProblemAreaID		SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6
SolutionTag			Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	-	-	Upgrd;Drop	Upgrd;Drop	Upgrd;Drop	
Trunk or Focus Area ID	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH
Engineering Validation Check															
Engineering Validation Fix															
expr:US_Cover	2.6	1.9	2.7	2.8	2.8	3.4	4.7	2.8	3.2	3.8	3.7	3.6	3.5	3.2	2.7
expr:DS_Cover	1.7	1.7	2.8	2.8	3.4	4.7	2.8	3.2	3.7	3.7	3.5	3.4	3.1	2.7	3.6
surc	0.60	0.58	0.63	0.61	0.67	0.71	0.69	0.74	0.75	0.75	0.78	0.79	0.79	0.43	0.41
DS flow (m3/s)	0.02206	0.02597													0.05666

Node	-	306709	306712	306710	306474	306535	310392	306536	306538	306537	306540	306539	306541	306542	306543	-
Node type	-	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-	Manhole	Manhole	Manhole	Manhole	-
ground (m AD)	-	329.140	328.550	328.440	328.000	328.335	329.248	326.770	326.805	327.018	326.743	326.440	326.101	325.585	323.329	-
ProblemAreaID		SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6	SA_6
SolutionTag																
Trunk or Focus Area ID	-	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-
Engineering Validation Check		GL_diff		GL_diff		IPI										
Engineering Validation Fix			GL_ELEV	GL_ELEV	GL_ELEV	IPI_FX		GL_ELEV								
expr:HGL	-	2.008958	2.759564	2.941831	2.917755	3.493203	4.858992	2.893566	3.287849	3.845209	-	3.636106	3.518969	3.338510	2.907156	-

<u>Solution in model:</u>

Same solution as the existing and 2031 scenario.

See note & solution for existing conditions solutions.

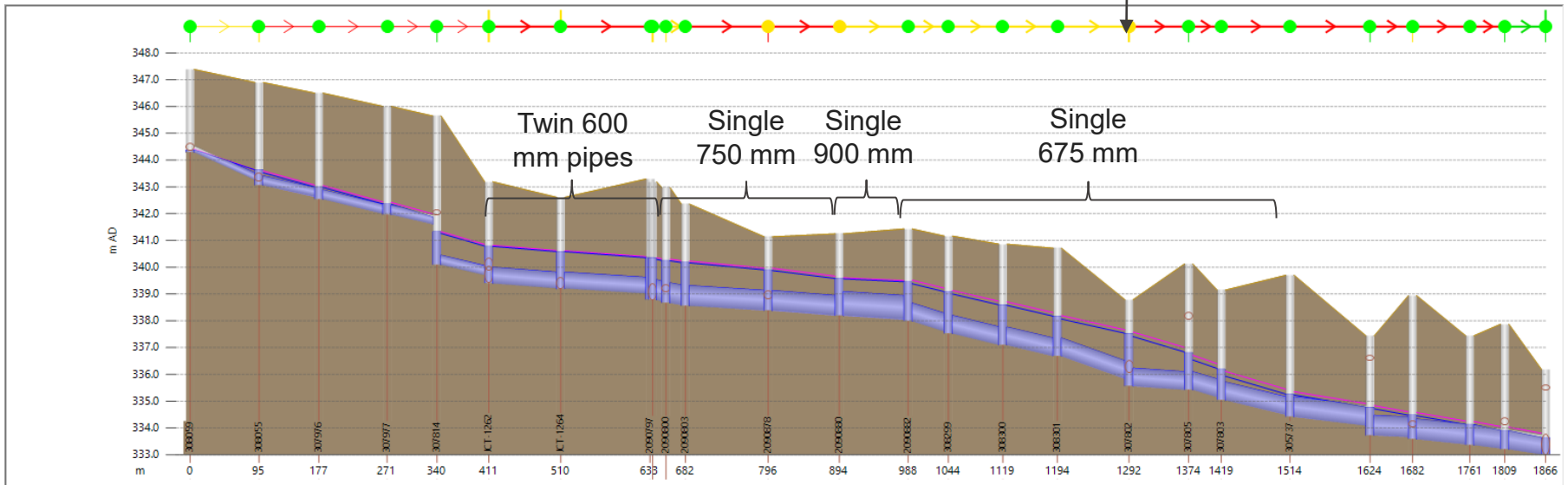
TWPAS: Total Wastewater Priority Assessment Score

2051 Conditions - 25yr Results - TRUNK

Upper Schneider - Near Highland Rd W

CB-4: Sandrock Trunk

DEM: 340.53 m
GIS: 338.785 m
Model: 338.787 m



Link	308059.1	308055.1	307976.1	307977.1	307814.1	JCT-1262.2	JCT-1264.1	-	-	2090803.1	2090878.1	2090880.1	-	308299.1	308300.1	308301.1	307802.1	-	307803.1	305737.1	-	305790.1	-	-
length (m)	94.9	82.3	93.9	68.7	71.2	99.2	122.8	-	-	113.9	97.9	94.6	55.5	75.0	75.0	98.6	82.0	44.9	94.6	110.2	58.4	78.9	48.0	56.3
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	-	-	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	350	350	350	350	600	600	-	-	750	750	900	675	675	675	675	675	675	675	750	750	750	750	750
us inv (m AD)	344.293	343.055	342.540	341.964	340.093	339.398	339.212	-	-	338.562	338.378	338.189	-	337.523	337.091	336.679	335.557	-	335.036	334.411	-	333.582	-	-
ds inv (m AD)	343.260	342.620	341.992	341.605	339.708	339.216	339.023	-	-	338.385	338.192	338.038	-	337.100	336.679	335.832	335.423	-	334.488	334.085	-	333.384	-	-
grad (m/m)	0.01088	0.00529	0.00584	0.00523	0.00540	0.00184	0.00154	-	-	0.00155	0.00190	0.00160	-	0.00564	0.00549	0.00859	0.00163	-	0.00579	0.00296	-	0.00251	-	-
pfc (m3/s)	0.062	0.106	0.111	0.106	0.107	0.263	0.241	-	-	0.439	0.485	0.723	0.696	0.631	0.623	0.779	0.340	0.653	0.640	0.606	0.360	0.558	0.568	0.650
Trunk or Focus Area ID						TRNK	TRNK						TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	-	TRNK
Engineering Validation Check																								
Engineering Validation Fix					DSI_AB								USI_AB											
surc	1.00	2.00	2.00	2.00	2.00	2.00	2.00	-	-	2.00	2.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.91
DS flow (m3/s)	0.01091	0.11601	0.11754	0.11893	0.12089	0.30229	0.25824	-	-	0.53026	0.60910	0.61064	-	0.61307	0.61321	0.61337	0.69943	-	0.70349	0.70350	-	0.70464	-	-

Node	-	308055	307976	307977	307814	JCT-1262	JCT-1264	-	-	-	2090878	2090880	-	-	308300	308301	307802	-	307803	305737	2087961	305790	-	-	-
Node type	-	Manhole	Manhole	Manhole	-	Manhole	Manhole	-	-	-	Manhole	Manhole	-	-	-	Manhole	Manhole	-	-	Manhole	Manhole	-	-	-	-
ground (m AD)	-	346.895	346.500	346.004	-	343.190	342.610	-	-	-	341.138	341.246	341.430	-	340.861	340.709	338.787	-	-	339.701	337.438	-	-	-	-
Trunk or Focus Area ID						TRNK	TRNK	TRNK						TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	-	-	-
Engineering Validation Check						-	BNFS/PD	DNP					IPD								GL_diff	-			
Engineering Validation Fix						-																			
expr:HGL	-	3.264446	3.505524	3.642947	-	2.407804	2.026992	-	-	-	1.238311	1.669340	-	-	-	2.547470	1.263532	-	-	4.443676	2.670452	-	-	-	-

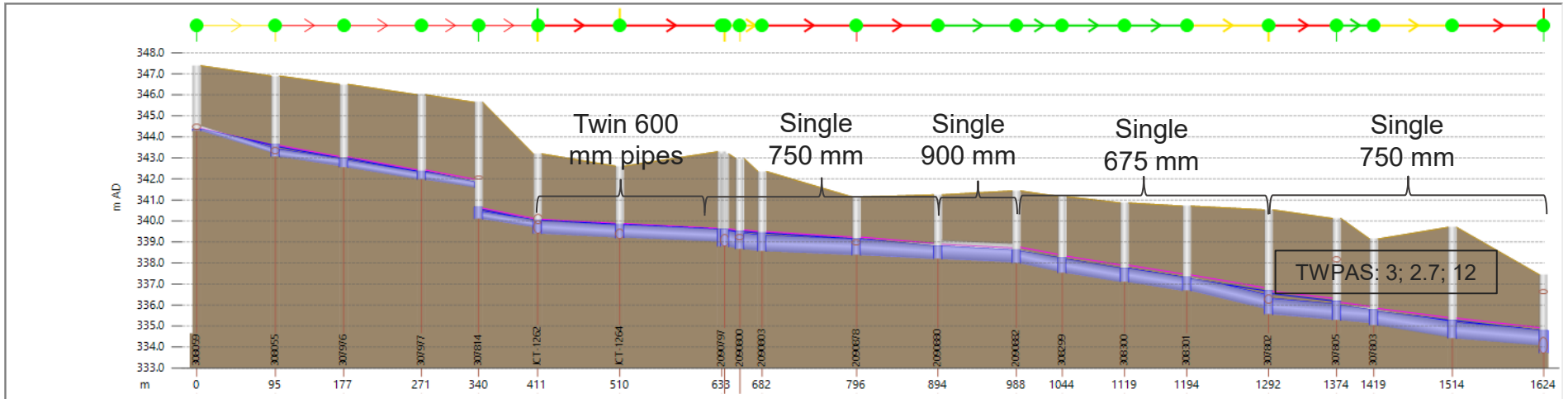
Note:
Same HGL issues observed as 2031 scenarios, but more surcharge issues observed in the 2051 scenario than in the 2031 scenario.
More HGL and surcharge issues observed in the 2051 scenario than in the existing scenario.

Recommendation:
Upgrade the pipes.

2051 Conditions Solutions - 25yr Results - TRUNK

Upper Schneider - Near Highland Rd W

SA-7: Sandrock Trunk



Link	308059.1	308055.1	307976.1	307977.1	307814.1	JCT-1262.2	JCT-1264.1	-	-	2090803.1	2090878.1	2090880.1	-	308299.1	308300.1	308301.1	307802.1	-	307803.1	305737.1
length (m)	94.9	82.3	93.9	68.7	71.2	99.2	122.8	-	-	113.9	97.9	94.6	55.5	75.0	75.0	98.6	82.0	44.9	94.6	110.2
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	-	-	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	250	350	350	350	350	600	600	-	-	750	750	900	675	675	675	675	750	750	750	750
us inv (m AD)	344.293	343.055	342.540	341.964	340.093	339.398	339.212	-	-	338.562	338.378	338.189	337.984	337.523	337.091	336.679	335.557	-	335.036	334.411
ds inv (m AD)	343.260	342.620	341.992	341.605	339.708	339.216	339.023	-	-	338.385	338.192	338.038	337.603	337.100	336.679	335.832	335.311	-	334.488	334.085
grad (m/m)	0.01088	0.00529	0.00584	0.00523	0.00540	0.00184	0.00154	-	-	0.00155	0.00190	0.00160	0.00686	0.00564	0.00549	0.00859	0.00300	-	0.00579	0.00296
pfc (m3/s)	0.062	0.106	0.111	0.106	0.107	0.263	0.241	-	-	0.439	0.485	0.723	0.696	0.631	0.623	0.779	0.610	0.597	0.847	0.606
ProblemAreaID	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	-	-	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	
SolutionTag																	Upgrd;Drop	-	Upgrd	
Trunk or Focus Area ID						TRNK	TRNK						TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK
Engineering Validation Check																				
Engineering Validation Fix					DSI_AB								USI_AB							
expr:US_Cover	2.8	3.5	3.6	3.7	5.2	3.2	2.8	-	3.6	3.0	2.0	2.2	2.8	3.0	3.1	3.4	4.2	4.1	3.4	4.5
expr:DS_Cover	3.4	3.5	3.7	3.7	3.1	2.8	3.7	-	3.0	2.0	2.3	2.5	2.9	3.1	3.4	4.0	4.1	3.2	4.5	2.6
surc	1.00	2.00	2.00	2.00	2.00	2.00	2.00	-	-	2.00	2.00	0.68	0.97	0.97	0.96	1.00	2.00	0.94	1.00	2.00
DS flow (m3/s)	0.01091	0.11601	0.11754	0.11893	0.12110	0.30231	0.26246	-	-	0.53569	0.61702	0.61636	0.61690	0.61766	0.61766	0.61789	0.70417	-	0.70800	0.70814

Node	-	308055	307976	307977	307814	JCT-1262	JCT-1264	-		2090803	2090878	2090880	2090882	308299	308300	308301	307802	307805	307803	305737	-
Node type	-	Manhole	Manhole	Manhole	-	Manhole	Manhole	-		-	Manhole	Manhole	Manhole	-	Manhole	Manhole	Manhole	-	-	Manhole	-
ground (m AD)	-	346.895	346.500	346.004	345.643	343.190	342.610	-		342.355	341.138	341.246	341.430	341.163	340.861	340.709	340.530	-	339.146	339.701	-
ProblemAreaID	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7		SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	SA_7	
SolutionTag																					
Trunk or Focus Area ID						TRNK	TRNK	TRNK						TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK	TRNK
Engineering Validation Check						-	BNFS;IPD	DNP					IPD								-
Engineering Validation Fix						-											GL_ELEV				
expr:HGL	-	3.264446	3.505524	3.642947	-	3.151212	2.769851	-		-	1.982055	2.438505	2.811165	-	3.106636	3.389969	3.851350	-	-	4.418163	-

<u>Solution in model:</u>

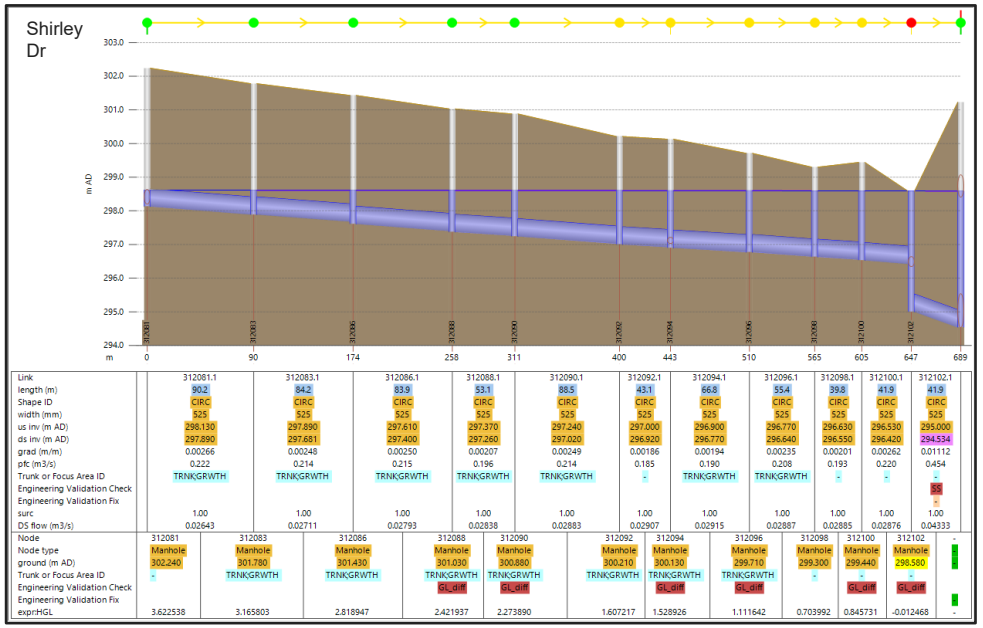
Same solution as the existing and 2031 scenario.

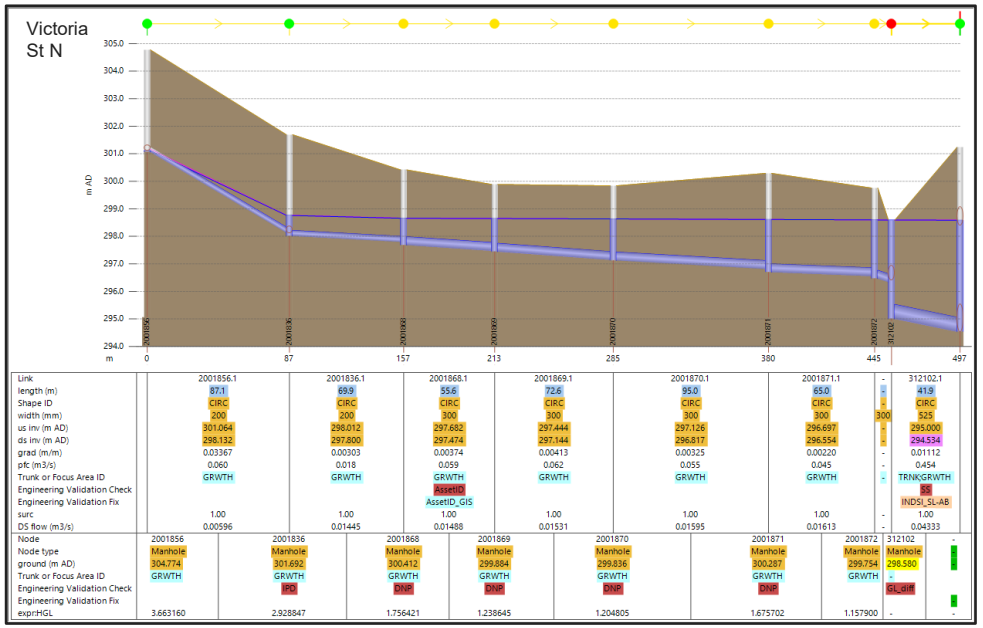
See note & solution for existing conditions solutions.

TWPAS: Total Wastewater Priority Assessment Score

2051 Conditions - 25yr Results - TRUNK

Montgomery – Victoria North (1 of 2)
CB-5: Shirley Dr – U/S of Shirley SPS



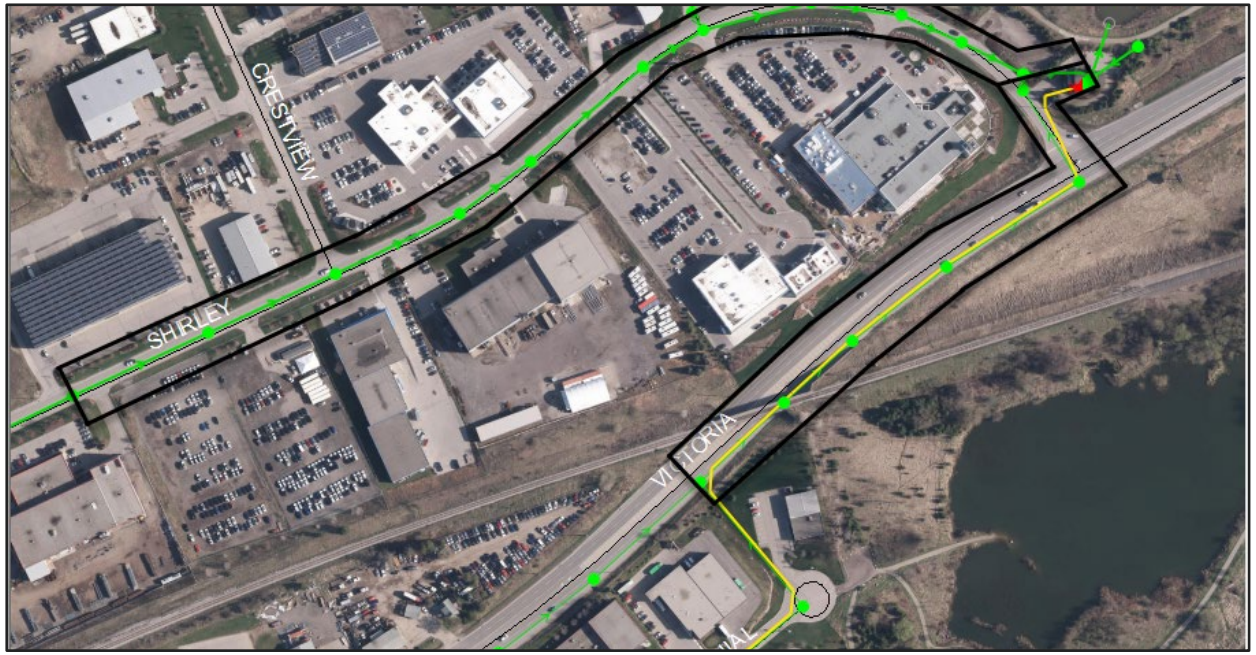


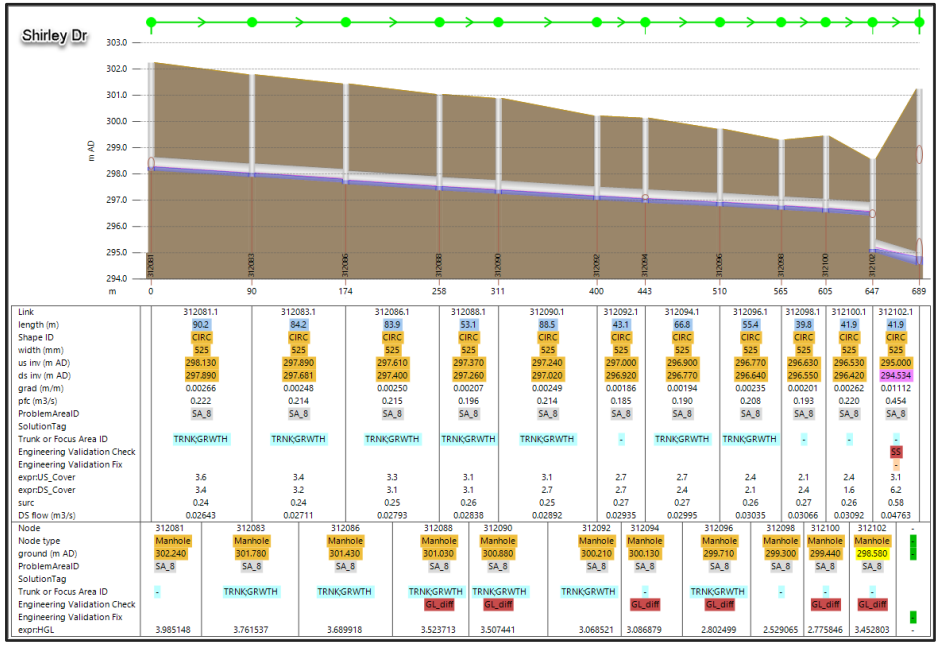
Note:
Same HGL and surcharge issues observed as the existing and 2031 scenarios.
See note & recommendation for existing conditions.

2051 Conditions Solutions - 25yr Results - TRUNK

Montgomery – Victoria North

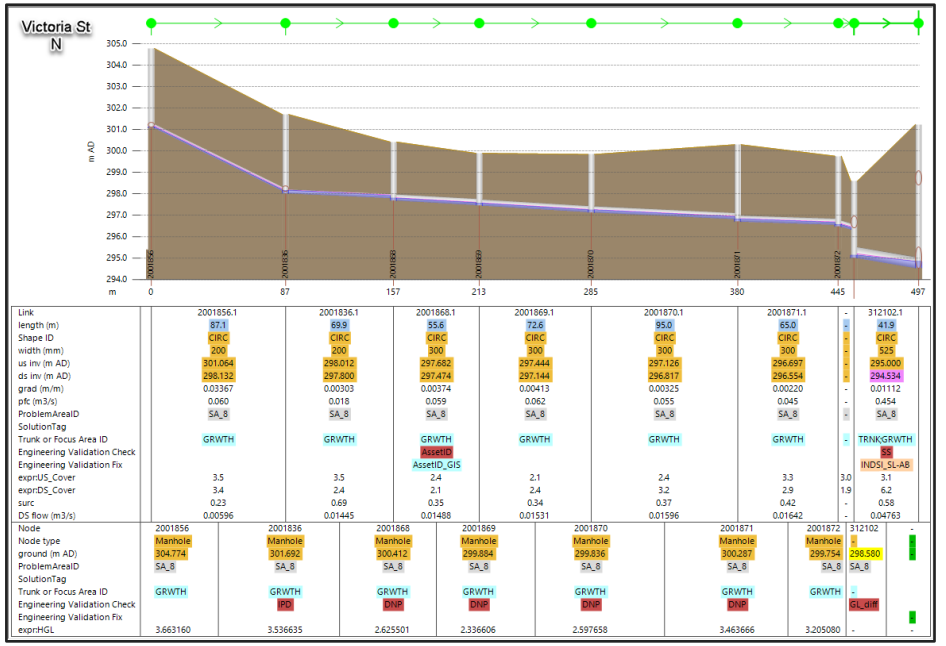
SA-8: Shirley Dr and Victoria St N – U/S of Shirley SPS





Link	312081.1	312083.1	312086.1	312088.1	312090.1	312092.1	312094.1	312096.1	312098.1	312100.1	312102.1
length (m)	90.2	84.2	83.9	53.1	88.5	43.1	66.8	55.4	39.8	41.9	41.9
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	525	525	525	525	525	525	525	525	525	525	525
us inv (m AD)	298.130	297.890	297.610	297.370	297.240	297.000	296.900	296.770	296.630	296.530	295.000
ds inv (m AD)	297.890	297.681	297.400	297.260	297.020	296.920	296.770	296.640	296.550	296.420	294.534
grad (m/m)	0.00266	0.00248	0.00250	0.00207	0.00249	0.00186	0.00194	0.00235	0.00201	0.00262	0.01112
pfc (m3/s)	0.222	0.214	0.215	0.196	0.214	0.185	0.190	0.208	0.193	0.220	0.454
ProblemAreaID	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8
SolutionTag											
Trunk or Focus Area ID	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	-	TRNKGRWTH	TRNKGRWTH	-	-	-
Engineering Validation Check											SS
Engineering Validation Fix											-
exprUS_Cover	3.6	3.4	3.3	3.1	3.1	2.7	2.7	2.4	2.1	2.4	3.1
exprDS_Cover	3.4	3.2	3.1	3.1	2.7	2.7	2.4	2.1	2.4	1.6	6.2
surc	0.24	0.24	0.25	0.26	0.25	0.27	0.27	0.26	0.27	0.26	0.58
DS flow (m3/s)	0.02643	0.02711	0.02793	0.02838	0.02892	0.02935	0.02995	0.03035	0.03066	0.03092	0.04763

Node	312081	312083	312086	312088	312090	312092	312094	312096	312098	312100	312102	-
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	
ground (m AD)	302.240	301.780	301.430	301.030	300.880	300.210	300.130	299.710	299.300	299.440	298.580	
ProblemAreaID	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	
SolutionTag												
Trunk or Focus Area ID	-	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	TRNKGRWTH	-	TRNKGRWTH	-	-	-	
Engineering Validation Check				GL_diff	GL_diff		GL_diff	GL_diff		GL_diff	GL_diff	
Engineering Validation Fix												
exprHGL	3.985148	3.761537	3.689918	3.523713	3.507441	3.068521	3.086879	2.802499	2.529065	2.775846	3.452803	-



Link	2001856.1	2001836.1	2001868.1	2001869.1	2001870.1	2001871.1	-	312102.1
length (m)	87.1	69.9	55.6	72.6	95.0	85.0	-	41.9
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	-	CIRC
width (mm)	200	200	300	300	300	300	-	525
us inv (m AD)	301.064	298.012	297.682	297.444	297.126	296.697	-	295.000
ds inv (m AD)	298.132	297.800	297.474	297.144	296.817	296.554	-	294.534
grad (m/m)	0.03367	0.00303	0.00374	0.00413	0.00325	0.00220	-	0.01112
pfc (m3/s)	0.060	0.018	0.059	0.062	0.055	0.045	-	0.454
ProblemAreaID	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	-	SA_8
SolutionTag								
Trunk or Focus Area ID	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-	TRNKGRWTH
Engineering Validation Check			AssetID					SS
Engineering Validation Fix			AssetID_GIS					INDSI_SL-AB
exprUS_Cover	3.5	3.5	2.4	2.1	2.4	3.3	3.0	3.1
exprDS_Cover	3.4	2.4	2.1	2.4	3.2	2.9	1.9	6.2
surc	0.23	0.69	0.35	0.34	0.37	0.42	-	0.58
DS flow (m3/s)	0.00596	0.01445	0.01488	0.01531	0.01596	0.01642	-	0.04763

Node	2001856	2001836	2001868	2001869	2001870	2001871	2001872	312102	-
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	-	
ground (m AD)	304.774	301.692	300.412	299.884	299.836	300.287	299.754	298.580	
ProblemAreaID	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	SA_8	
SolutionTag									
Trunk or Focus Area ID	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	GRWTH	-	
Engineering Validation Check		PD	DNP	DNP	DNP	DNP		GL_diff	
Engineering Validation Fix									
exprHGL	3.663160	3.536635	2.625501	2.336606	2.597658	3.463666	3.205080	-	-

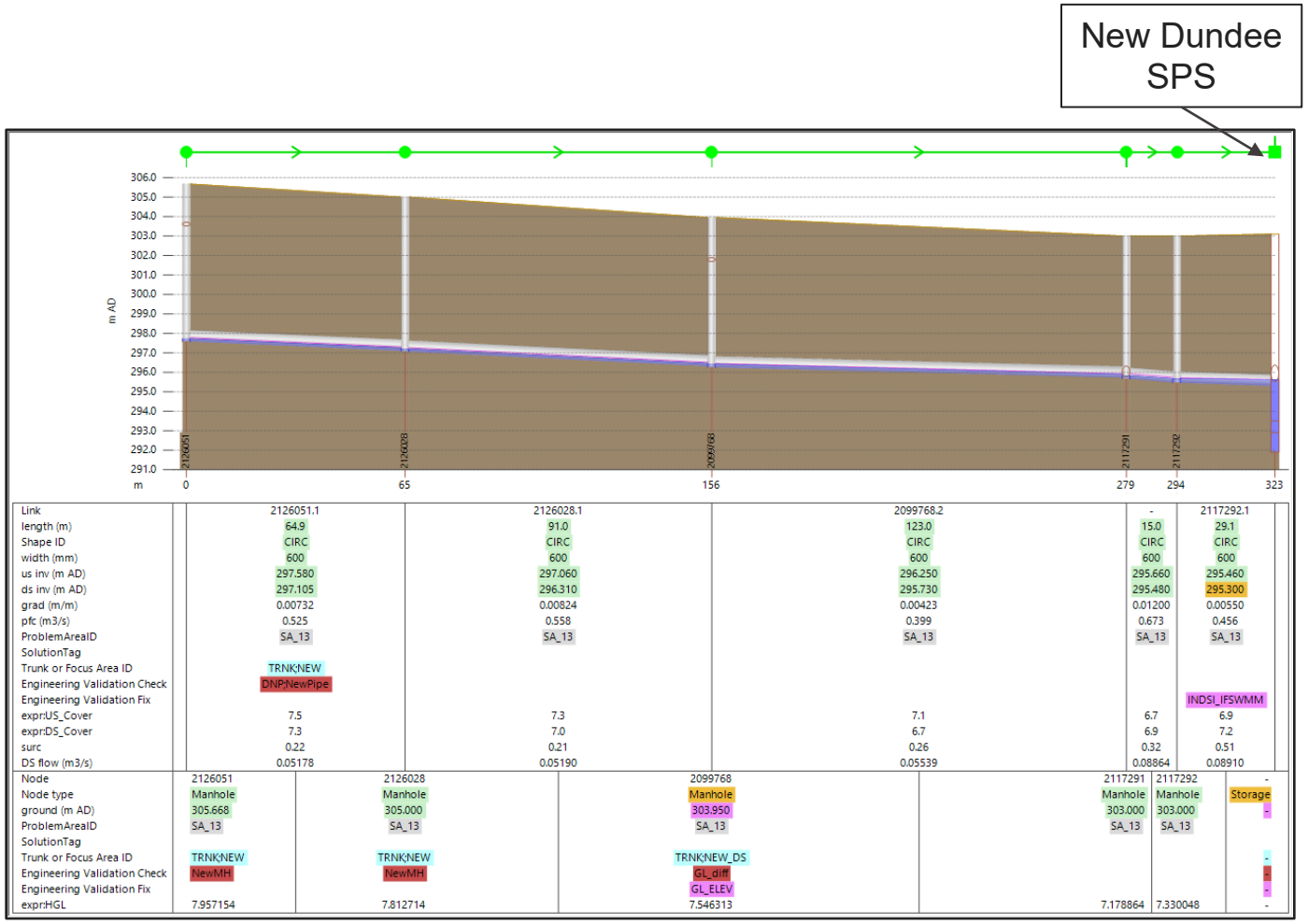
<u>Solution in model:</u>

Same solution as the existing and 2031 scenario.

See note & solution for existing conditions solutions.

2051 Conditions Solutions - 25yr Results - TRUNK

SA-13: New Dundee SPS



Link	2126051.1	2126028.1	2099768.2	-	2117292.1
length (m)	64.9	91.0	123.0	15.0	29.1
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	600	600	600	600	600
us inv (m AD)	297.580	297.060	296.250	295.660	295.460
ds inv (m AD)	297.105	296.310	295.730	295.480	295.300
grad (m/m)	0.00732	0.00824	0.00423	0.01200	0.00550
pfc (m3/s)	0.525	0.558	0.399	0.673	0.456
ProblemAreaID	SA_13	SA_13	SA_13	SA_13	SA_13
SolutionTag					
Trunk or Focus Area ID	TRNK;NEW				
Engineering Validation Check	DNP;NewPipe				
Engineering Validation Fix					INDSI_IFSWMM
expr:US_Cover	7.5	7.3	7.1	6.7	6.9
expr:DS_Cover	7.3	7.0	6.7	6.9	7.2
surc	0.22	0.21	0.26	0.32	0.51
DS flow (m3/s)	0.05178	0.05190	0.05539	0.08864	0.08910

Node	2126051	2126028	2099768	2117291	2117292	-
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Storage
ground (m AD)	305.668	305.000	303.950	303.000	303.000	-
ProblemAreaID	SA_13	SA_13	SA_13	SA_13	SA_13	
SolutionTag						
Trunk or Focus Area ID	TRNK;NEW	TRNK;NEW	TRNK;NEW_DS			-
Engineering Validation Check	NewMH	NewMH	GL_diff			-
Engineering Validation Fix			GL_ELEV			-
expr:HGL	7.957154	7.812714	7.546313	7.178864	7.330048	-

Note:

Significant new development (13,205 people) for 2051.

The growth areas are connected to Dodge Dr based on the Growth Management Plan.

The 10yr peak flow is higher than the firm capacity of New Dundee SPS.

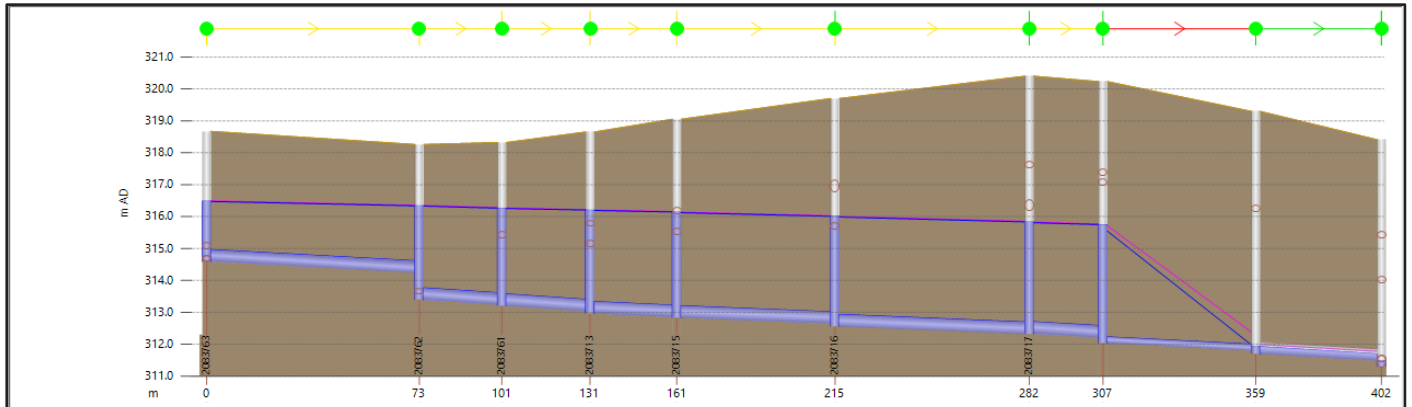
Solution in model:

Upgrade New Dundee SPS capacity to 75 L/s (based on 2051 10yr peak flow).

2051 Conditions Solutions - 25yr Results - LOCAL

Robert Ferrie

CB-7: Downstream of New Dundee SPS



Link	2083763.1	2083762.1	2083761.1	2083713.1	2083715.2	2083716.1	2083717.1	2083718.1	2097077.1
length (m)	72.8	28.2	30.2	29.7	54.2	66.5	25.2	52.3	43.0
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	375	375	375	375	375	375	375	200	375
us inv (m AD)	314.590	313.390	313.200	312.960	312.830	312.560	312.330	312.030	311.696
ds inv (m AD)	314.240	313.240	313.030	312.850	312.640	312.320	312.210	311.800	311.481
grad (m/m)	0.00481	0.00531	0.00562	0.00371	0.00351	0.00361	0.00476	0.00440	0.00500
pfc (m3/s)	0.122	0.128	0.132	0.107	0.104	0.105	0.121	0.022	0.124
ProblemAreaID									
SolutionTag									
Trunk or Focus Area ID	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS
Engineering Validation Check	PAG								
Engineering Validation Fix	PAG_FX								
expr:US_Cover	3.7	4.5	4.7	5.3	5.8	6.8	7.7	8.0	7.2
expr:DS_Cover	3.6	4.7	5.2	5.8	6.7	7.7	7.6	7.3	6.6
surc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	0.60
DS flow (m3/s)	0.07996	0.08341	0.07533	0.07887	0.08301	0.08332	0.08338	0.08348	0.08355

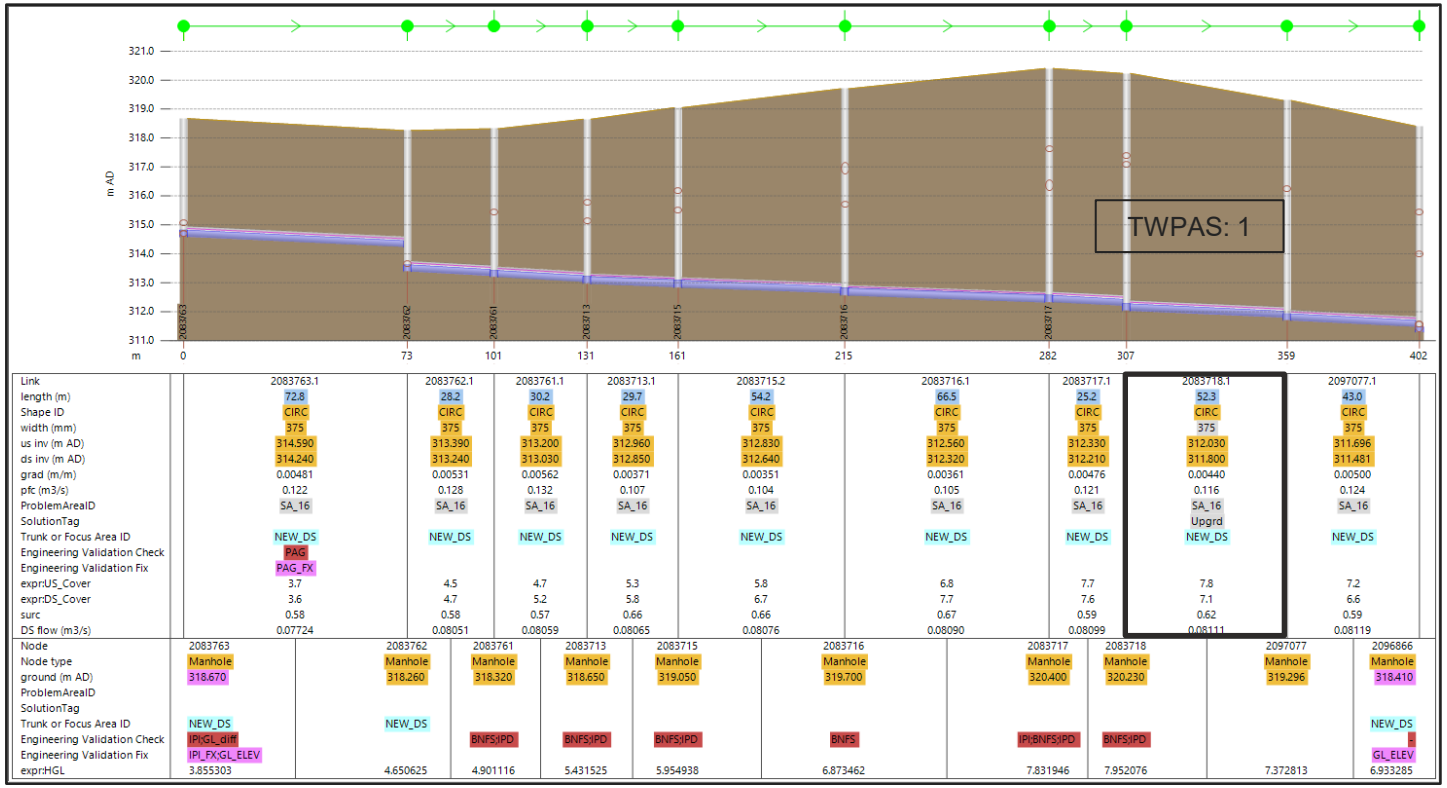
Node	2083763	2083762	2083761	2083713	2083715	2083716	2083717	2083718	2097077	2096866
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole
ground (m AD)	318.670	318.260	318.320	318.650	319.050	319.700	320.400	320.230	319.296	318.410
ProblemAreaID										
SolutionTag										
Trunk or Focus Area ID	NEW_DS	NEW_DS								NEW_DS
Engineering Validation Check	IPI;GL_diff		BNFS;IPD	BNFS;IPD	BNFS;IPD	BNFS	IPI;BNFS;IPD	BNFS;IPD		-
Engineering Validation Fix	IPI_FX;GL_ELEV									GL_ELEV
expr:HGL	2.183824	1.923666	2.057274	2.446753	2.907574	3.692371	4.569067	4.481648	7.368052	6.930599

Note:
Same HGL and surcharge issues observed as 2031 scenarios.
See note & recommendation for 2031 conditions.

2051 Conditions Solutions - 25yr Results - LOCAL

Robert Ferrie

SA-16: Downstream of New Dundee SPS



Link	2083763.1	2083762.1	2083761.1	2083713.1	2083715.2	2083716.1	2083717.1	2083718.1	2097077.1
length (m)	72.8	28.2	30.2	29.7	54.2	66.5	25.2	52.3	43.0
Shape ID	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC	CIRC
width (mm)	375	375	375	375	375	375	375	375	375
us inv (m AD)	314.590	313.390	313.200	312.960	312.830	312.560	312.330	312.030	311.696
ds inv (m AD)	314.240	313.240	313.030	312.850	312.640	312.320	312.210	311.800	311.481
grad (m/m)	0.00481	0.00531	0.00562	0.00371	0.00351	0.00361	0.00476	0.00440	0.00500
pfc (m3/s)	0.122	0.128	0.132	0.107	0.104	0.105	0.121	0.116	0.124
ProblemAreaID	SA_16	SA_16	SA_16	SA_16	SA_16	SA_16	SA_16	SA_16	SA_16
SolutionTag								Upgrd	
Trunk or Focus Area ID	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS	NEW_DS
Engineering Validation Check	PAG								
Engineering Validation Fix	PAG_FX								
expr:US_Cover	3.7	4.5	4.7	5.3	5.8	6.8	7.7	7.8	7.2
expr:DS_Cover	3.6	4.7	5.2	5.8	6.7	7.7	7.6	7.1	6.6
surc	0.58	0.58	0.57	0.66	0.66	0.67	0.59	0.62	0.59
DS flow (m3/s)	0.07724	0.08051	0.08059	0.08065	0.08076	0.08090	0.08099	0.08111	0.08119

Node	2083763	2083762	2083761	2083713	2083715	2083716	2083717	2083718	2097077	2096866
Node type	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole	Manhole
ground (m AD)	318.670	318.260	318.320	318.650	319.050	319.700	320.400	320.230	319.296	318.410
ProblemAreaID										
SolutionTag										
Trunk or Focus Area ID	NEW_DS	NEW_DS								NEW_DS
Engineering Validation Check	IPI;GL_diff		BNFS;IPD	BNFS;IPD	BNFS;IPD	BNFS	IPI;BNFS;IPD	BNFS;IPD		
Engineering Validation Fix	IPI_FX;GL_ELEV									GL_ELEV
expr:HGL	3.855303	4.650625	4.901116	5.431525	5.954938	6.873462	7.831946	7.952076	7.372813	6.933285

<u>Solution in model:</u>

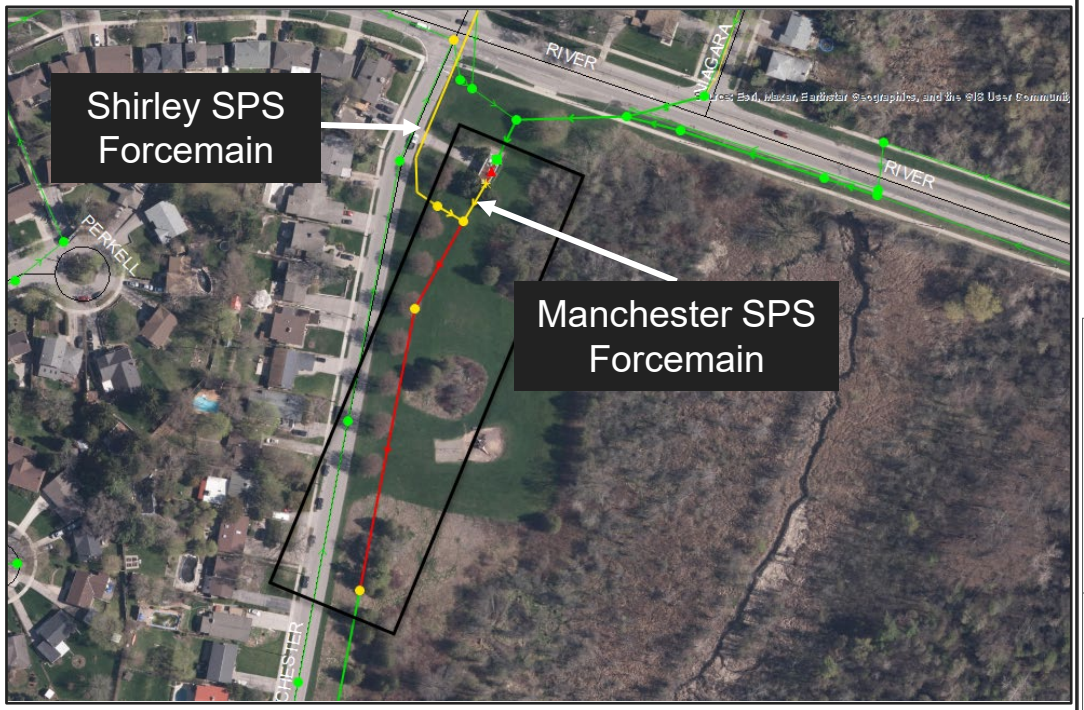
Same solution as the 2031 scenario.

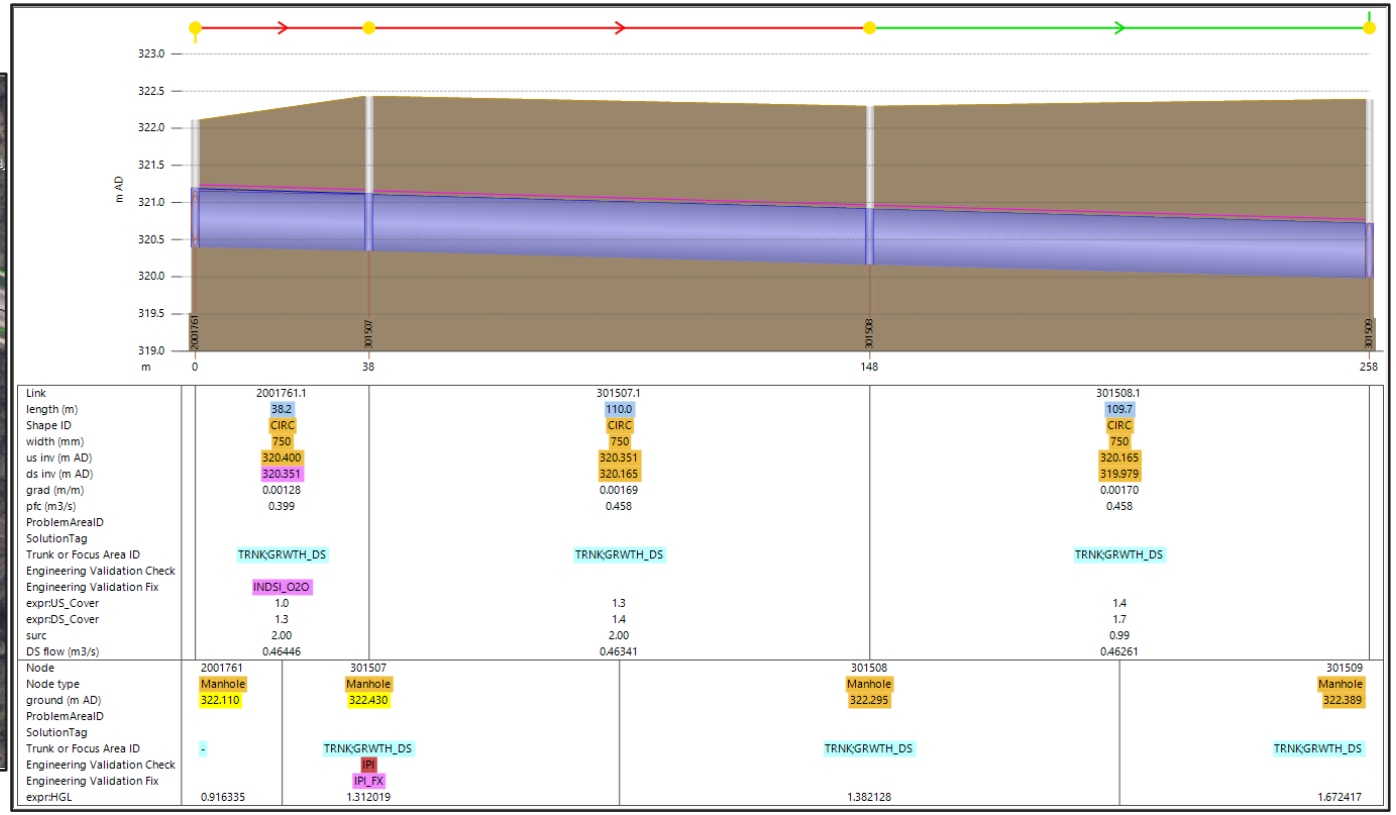
See note & solution for 2031 conditions.

TWPAS: Total Wastewater Priority Assessment Score

2051 Conditions with U/S Solutions - 25yr Results - TRUNK

CB-8: D/S of Manchester SPS & Shirley SPS





Link	2001761.1	301507.1	301508.1
length (m)	38.2	110.0	109.7
Shape ID	CIRC	CIRC	CIRC
width (mm)	750	750	750
us inv (m AD)	320.400	320.351	320.165
ds inv (m AD)	320.351	320.165	319.979
grad (m/m)	0.00128	0.00169	0.00170
pfc (m3/s)	0.399	0.458	0.458
ProblemAreaID			
SolutionTag			
Trunk or Focus Area ID	TRNK\GRWTH_DS	TRNK\GRWTH_DS	TRNK\GRWTH_DS
Engineering Validation Check			
Engineering Validation Fix	INDSI_O2O		
expr:US_Cover	1.0	1.3	1.4
expr:DS_Cover	1.3	1.4	1.7
surc	2.00	2.00	0.99
DS flow (m3/s)	0.46446	0.46341	0.46261

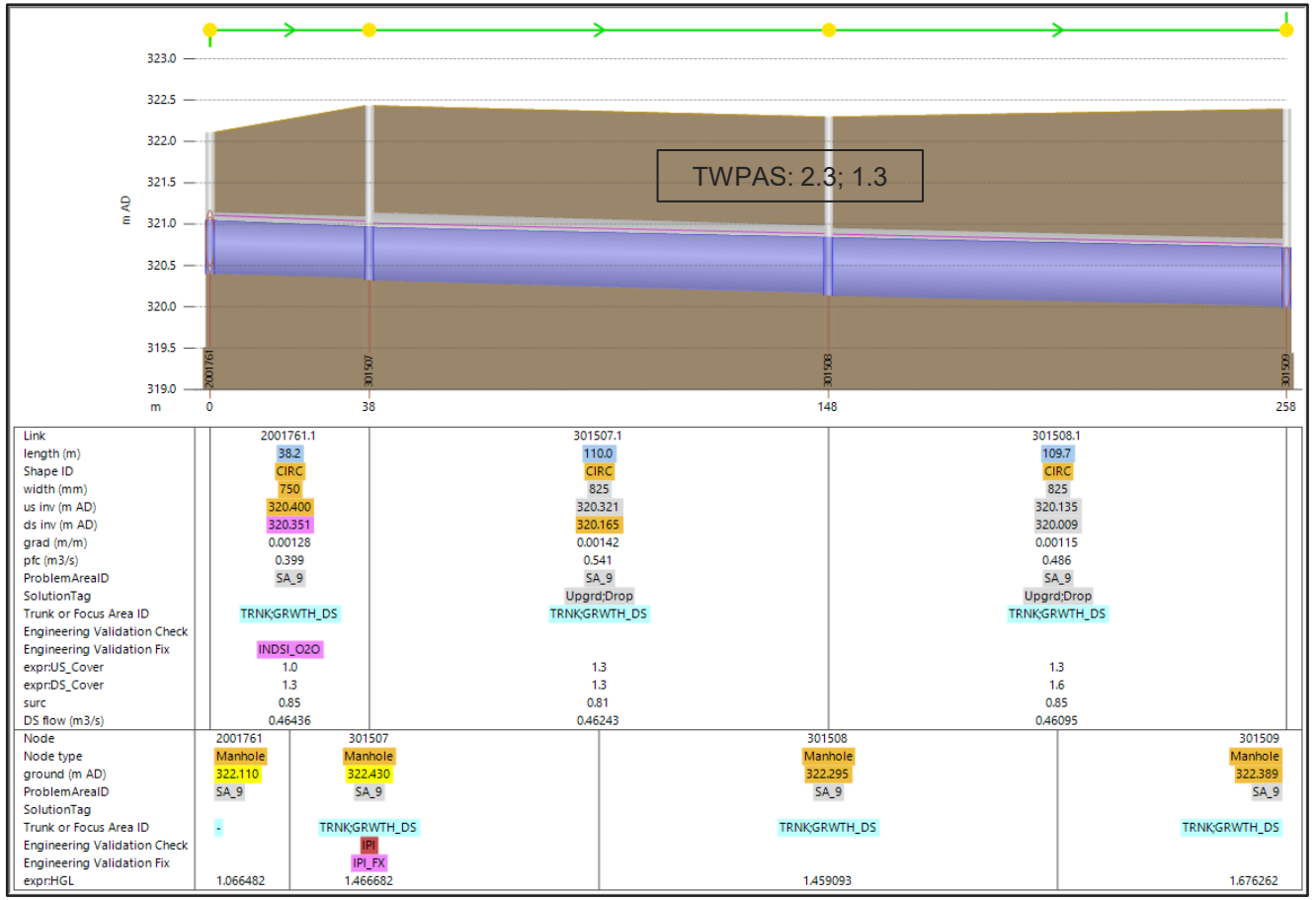
Node	2001761	301507	301508	301509
Node type	Manhole	Manhole	Manhole	Manhole
ground (m AD)	322.110	322.430	322.295	322.389
ProblemAreaID				
SolutionTag				
Trunk or Focus Area ID	-	TRNK\GRWTH_DS	TRNK\GRWTH_DS	TRNK\GRWTH_DS
Engineering Validation Check		IPI		
Engineering Validation Fix		IPI_FX		
expr:HGL	0.916335	1.312019	1.382128	1.672417

Note:

More HGL and surcharge issues observed in the 2051 scenario than in the existing and 2031 scenarios.

2051 Conditions Solutions - 25yr Results - TRUNK

SA-9: D/S of Manchester SPS & Shirley SPS



Link	2001761.1	301507.1	301508.1
length (m)	38.2	110.0	109.7
Shape ID	CIRC	CIRC	CIRC
width (mm)	750	825	825
us inv (m AD)	320.400	320.321	320.135
ds inv (m AD)	320.351	320.165	320.009
grad (m/m)	0.00128	0.00142	0.00115
pfc (m3/s)	0.399	0.541	0.486
ProblemAreaID	SA_9	SA_9	SA_9
SolutionTag		Upgrd;Drop	Upgrd;Drop
Trunk or Focus Area ID	TRNK;GRWTH_DS	TRNK;GRWTH_DS	TRNK;GRWTH_DS
Engineering Validation Check			
Engineering Validation Fix	INDSI_O2O		
expr:US_Cover	1.0	1.3	1.3
expr:DS_Cover	1.3	1.3	1.6
surc	0.85	0.81	0.85
DS flow (m3/s)	0.46436	0.46243	0.46095

Node	2001761	301507	301508	301509
Node type	Manhole	Manhole	Manhole	Manhole
ground (m AD)	322.110	322.430	322.295	322.389
ProblemAreaID	SA_9	SA_9	SA_9	SA_9
SolutionTag				
Trunk or Focus Area ID	-	TRNK;GRWTH_DS	TRNK;GRWTH_DS	TRNK;GRWTH_DS
Engineering Validation Check		IPI		
Engineering Validation Fix		IPI_FX		
expr:HGL	1.066482	1.466682	1.459093	1.676262

Solution in model:

Same solution as the 2031 scenario.

See note & solution for 2031 conditions solutions.

TWPAS: Total Wastewater Priority Assessment Score

B.2 - TABLE OF ALL PIPE IDS AND CHARACTERISTICS RECOMMENDED FOR UPGRADE

Existing and Future Conditions Capacity-Based Sewer Solutions

CB-1	Upstream of King St SPS	Replacement of 2 lengths of sewer - upsize from 300 dia. to 375 dia.	100468, 100469
CB-2	Dalewood	Alt B - Replacement of 3 lengths of sewer on Dalewood, 2 lengths of sewer on Penrose and one length of sewer through the easement - all pipes upgraded to 300mm dia.	2129581, 2129580, 2129579, 1011151, 101152, 101361
CB-3	Homer Watson	Alt A - Replacement of 7 lengths of sewer on Homer Watson due to capacity, replacement of 2 lengths of sewer on comm. property due to capacity/condition, replacement of 7 lengths of sewer on Alpine due to capacity/condition, replacement of 2 lengths of sewer on Flint due to capacity, replacement of 1 length of sewer on Kingswood due to condition.	107139, 107140, 107126, 107122, 107123, 107162, 107163, 107164, 107165, 107166, 107129, 118006, 107125, 118274, 2119959, 107124, 2119718, 107136
CB-4	Upper Schneider - Sandrock	Replacement of 3 lengths of sewer - upsizing from 675mm dia to 750mm dia.	108887, 108888, 106767
CB-5	Shirley SPS	Increase PS to 378 L/s firm capacity - project involves addition of pumps to accomodate higher flows	
CB-6	New Dundee PS	Increase PS to 75 L/s firm capacity - project involves adding two new pumps	
CB-7	Robert Ferrie	Replacement of 1 length of sewer downstream of New Dundee FM discharge to 375mm dia.	2083719
CB-8	Manchester	Replacement of 2 lengths of sewer to 825mm diameter downstream of Shirley and Manchester SPS discharge	101713, 101714

APPENDIX C – ALTERNATIVE 4 RECOMMENDED SOLUTIONS – RELEVANT PIPE IDS

Total No. Of Pipes for CCTV Near-Term = 919

200	CCTV Near-Term		
Count	Pipe ID	CCTV Score	Install Year
1	2132898	3.3	1956
2	2090884	1.7	1976
3	2046053	1.8	1974
4	2007056	3.5	1988
5	2001625	0.6	1995
6	2001623	0.6	1995
7	2001621	0.6	1995
8	119605	0.5	1997
9	119023	1.3	1982
10	119014	1.2	1984
11	119012	0.7	1992
12	119008	1.7	1976
13	119007	0.7	1992
14	119006	1.3	1982
15	119005	1.3	1982
16	119004	1.3	1982
17	119003	1.3	1982
18	119002	0.7	1992
19	118864	0.5	1997
20	118859	0.5	1997
21	118856	0.5	1997
22	118854	0.5	1997
23	118851	0.5	1997
24	118849	0.5	1997
25	118771	2.4	1966
26	118651	3.2	1957
27	118650	2.5	1965
28	118548	1.3	1982
29	118546	0.8	1991
30	118544	1	1960
31	118532	1.7	1975
32	108313	0	1996
33	118332	1.8	1974
34	2001634	0	1995
35	118319	0.7	1992
36	118318	0.7	1992
37	118317	0.7	1992
38	118316	0.7	1992
39	118315	0.7	1992
40	118303	2.3	1967
41	118302	2.3	1967
42	118297	0	1985
43	118282	0.7	1992
44	118280	0.6	1995
45	118279	0.6	1995
46	118267	1.8	1974
47	118266	2	1966
48	118199	1.9	1973
49	118180	0.7	1992
50	118172	0	1995
51	118170	0	1995
52	118169	0	1995
53	110306	0	1995
54	110305	0	1995
55	110302	0	1995
56	110301	0	1995
57	110300	0	1995
58	108314	0	1995
59	118070	0.5	1997
60	100389	0	1995
61	110484	0	1994
62	110483	0	1994
63	118018	3.9	1950
64	118008	2.2	1968
65	118001	0.7	1992
66	114418	0.9	1988
67	111067	0.7	1992
68	110482	0	1994
69	110481	0	1994
70	110304	0	1994
71	110303	0	1994
72	118113	0	1993
73	118112	0	1993
74	118111	0	1993
75	118110	0	1993
76	118109	0	1993
77	110918	1.3	1981
78	110675	0	1993
79	110674	0	1993
80	110673	0	1993
81	110912	1.4	1980
82	110911	1.3	1981
83	106947	0	1993
84	106939	0	1993
85	110908	1.5	1978
86	106938	0	1993
87	102565	0	1993
88	102321	0	1993
89	102320	0	1993
90	110311	0	1992
91	110310	0	1992
92	110309	0	1992
93	110308	0	1992
94	110307	0	1992
95	109992	0	1992
96	110890	1	1975
97	109991	0	1992
98	109990	0	1992
99	108383	0	1992
100	110869	1.3	1981
101	110868	0	1975
102	110867	0	1981
103	110866	0	1981
104	110865	0	1981
105	110862	0	1981
106	110861	0	1981
107	110860	0	1981
108	110859	0	1980
109	110847	0	1975
110	110829	0	1965
111	106943	0	1992
112	110672	2	1990
113	110548	0	1991
114	109993	0	1991
115	109988	0	1991
116	109987	0	1991
117	108904	0	1991
118	108903	0	1991
119	108902	0	1991
120	108901	0	1991
121	108900	0	1991
122	108899	0	1991
123	108898	0	1991
124	108897	0	1991
125	110584	1.4	1980
126	108896	0	1991
127	108895	0	1991
128	118023	0	1990
129	110563	3	1979
130	110711	0	1990
131	110710	0	1990
132	110700	0	1990
133	110698	0	1990
134	110697	0	1990
135	110696	0	1990
136	110678	0	1990
137	110677	0	1990
138	110676	0	1990
139	110517	0	1996
140	110516	0	1996
141	110515	0	1996
142	110514	0	1996
143	110513	0	1996
144	110512	0	1996
145	110510	0	1995
146	110509	0	1995
147	110508	0	1995
148	110507	0	1995
149	110505	0	1995
150	110671	0	1990
151	110670	0	1990
152	110669	0	1990
153	103179	0	1990
154	103178	0	1990
155	103173	0	1990
156	103172	0	1990
157	103171	0	1990
158	103167	0	1990
159	103164	0	1990
160	103163	0	1990
161	103162	0	1990
162	103161	0	1990
163	100394	0	1990
164	100393	0	1990
165	103079	0	1989
166	110032	0	1979
167	110022	0	1979
168	110021	0	1979
169	110019	0	1977
170	103070	0	1989
171	103069	0	1989
172	103068	0	1989
173	103067	0	1989
174	103059	0	1989
175	103058	0	1989
176	110668	0	1988
177	110639	0	1988
178	109984	0	1996
179	109983	0	1996
180	109982	0	1996
181	109903	1.6	1977
182	109902	1.6	1977
183	110638	0	1988
184	109894	2	1977
185	110637	0	1988
186	110636	0	1988
187	110635	0	1988
188	110634	0	1988
189	110633	0	1988
190	110632	0	1988
191	103074	0	1988
192	103073	0	1988
193	102725	0	1987
194	102724	0	1987
195	102722	0	1987
196	102721	0	1987
197	102720	0	1987
198	106412	0	1986
199	106409	0	1986
200	104169	0	1986

200	CCTV Near-Term		
Count	Pipe ID	CCTV Score	Install Year
201	103963	0	1986
202	108754	1.6	1977
203	108682	0	1992
204	108681	0.7	1992
205	108667	0	1968
206	108666	2.2	1968
207	108665	0	1968
208	108664	0	1968
209	108663	2.2	1968
210	108662	2.2	1969
211	108661	0.7	1992
212	108660	0.7	1992
213	108659	0.7	1992
214	108611	0	1964
215	108604	0	1963
216	108603	0	1964
217	108579	0	1963
218	108516	0	1964
219	108514	0	1964
220	108405	0	1964
221	108396	2	1964
222	108389	1.9	1972
223	108384	0	1992
224	108317	1.1	1985
225	108331	2.2	1969
226	119021	0	1984
227	103032	0	1984
228	102962	0	1984
229	108320	1.9	1972
230	108319	1.9	1972
231	106453	0	1983
232	108315	1.9	1972
233	106451	0	1983
234	106420	0	1983
235	106419	0	1983
236	108310	0	1970
237	108309	0	1958
238	108308	1.9	1972
239	108307	0	1958
240	106418	0	1983
241	106417	0	1983
242	108297	2	1961
243	108296	3.1	1958
244	108295	2.3	1967
245	108294	2.3	1967
246	108293	2.3	1967
247	108292	2.4	1966
248	108291	2.4	1966
249	108290	2.3	1967
250	108289	2.3	1967
251	106414	0	1983
252	104832	0	1983
253	103408	0	1983
254	103407	0	1983
255	110827	0	1982
256	108146	0	1986
257	108128	0	1987
258	108062	1.4	1980
259	108061	1.4	1980
260	108048	1.4	1980
261	108047	1.4	1980
262	104050	0	1982
263	104036	0	1982
264	108002	3.1	1958
265	107898	2.2	1968
266	107897	2.2	1968
267	107888	2.2	1968
268	107872	2.2	1968
269	107871	2.2	1968
270	107870	2.2	1968
271	103984	0	1982
272	103784	0	1982
273	103783	0	1982
274	102961	0	1982
275	102960	0	1982
276	102959	0	1982
277	102958	0	1982
278	102957	0	1982
279	102955	0	1982
280	102954	0	1982
281	102953	0	1982
282	102952	0	1982
283	102949	0	1982
284	102944	0	1982
285	102941	0	1982
286	102938	0	1982
287	102937	0	1982
288	110873	0	1981
289	110872	0	1981
290	110871	0	1981
291	106464	0	1981
292	106463	0	1981
293	106460	0	1981
294	106459	0	1981
295	106458	0	1981
296	106456	0	1981
297	102131	0	1981
298	107719	2.2	1968
299	107705	2	1970
300	107703	2.2	1969
301	107702	2.2	1969
302	107701	2.2	1969
303	107700	2.1	1970
304	110906	0	1980
305	110905	0	1980
306	110904	0	1980
307	110903	0	1980
308	110902	0	1980
309	110901	0	1980
310	110896	0	1980
311	110895	0	1980
312	110640	0	1980
313	110583	0	1980
314	110565	0	1980
315	110555	0	1980
316	110554	0	1980
317	110553	0	1980
318	110910	0	1979
319	110899	0	1979
320	110898	0	1979
321	110897	0	1979
322	110564	0	1979
323	107272	1.9	1972
324	107271	1.9	1972
325	107270	1.9	1972
326	107213	0	1971
327	107149	0.7	1993
328	107148	0.7	1993
329	107103	0.7	1992
330	107100	0.7	1992
331	107097	0.7	1992
332	107096	0.7	1992
333	110562	0	1979
334	107068	3.3	1956
335	107067	3.3	1956
336	107066	3.3	1956
337	107065	3.3	1956
338	107034	3.3	1956
339	107032	3.3	1956
340	107031	3.3	1956
341	107030	3.3	1956
342	107020	3.4	1955
343	107019	3.4	1955
344	107018	3.3	1956
345	107004	0.9	1988
346	107003	1	1986
347	107000	0.9	1988
348	106999	0.9	1988
349	106998	0.9	1988
350	106997	0.9	1988
351	106995	0.9	1988
352	106994	3.1	1958
353	106989	2.2	1969
354	106988	2.2	1969
355	106987	2.2	1969
356	106959	0.7	1992
357	106948	0.6	1995
358	110561	0	1979
359	106942	0.7	1993
360	110559	0	1979
361	110558	0	1979
362	106928	2.1	1970
363	106927	2.1	1970
364	106926	2.1	1970
365	106906	3.3	1956
366	106905	3.3	1956
367	106833	0.6	1995
368	106832	0.6	1996
369	106831	0.6	1996
370	106830	0.6	1995
371	106818	0.6	1995
372	106814	0.6	1995
373	106813	0.6	1996
374	106812	0.6	1996
375	106810	1.5	1979
376	106808	1.5	1979
377	106804	0.6	1996
378	106803	1.5	1979
379	106766	2	1974
380	106620	0	1953
381	103273	0	1979
382	103272	0	1979
383	106603	0	1951
384	106564	1	1952
385	106561	1.7	1952
386	106560	1.9	1952
387	106521	2.3	1953
388	103271	0	1979
389	103270	0	1979
390	106479	1.6	1977
391	106478	1.6	1977
392	106472	1.6	1977
393	106471	1.4	1980
394	106470	1	1954
395	106469	1.4	1980
396	106467	1.4	1980
397	106466	1.4	1980
398	100488	0	1979
399	118028	0	1978
400	110909	0	1978

200	CCTV Near-Term		
Count	Pipe ID	CCTV Score	Install Year
401	110875	0	1978
402	110874	0	1978
403	106457	2	1981
404	110870	0	1978
405	107548	0	1978
406	107547	0	1978
407	107069	0	1978
408	106465	0	1978
409	100487	0	1978
410	100486	0	1978
411	100485	0	1978
412	110020	0	1977
413	110018	0	1977
414	110017	0	1977
415	106408	2	1987
416	106404	2	1988
417	106400	2	1978
418	109895	0	1977
419	108753	0	1977
420	108752	0	1977
421	106480	0	1977
422	118168	0	1976
423	118167	0	1976
424	108862	0	1976
425	108853	0	1976
426	106027	3.7	1952
427	105961	0	1965
428	108774	0	1976
429	108773	0	1976
430	105864	2.3	1967
431	108772	0	1976
432	105857	1.5	1978
433	105854	1.5	1978
434	105853	1.5	1978
435	108759	0	1976
436	108758	0	1976
437	108757	0	1976
438	108751	0	1976
439	105796	2.3	1967
440	105795	2.3	1967
441	105794	2.3	1967
442	105793	2.3	1967
443	105791	2.3	1967
444	105790	2.3	1967
445	105789	2.3	1967
446	105786	2.3	1967
447	105783	2.3	1967
448	105778	2.3	1967
449	105777	2.3	1967
450	105776	2.3	1967
451	105764	2.3	1967
452	105763	2.3	1967
453	105754	3.7	1952
454	105751	0	1953
455	105467	1.6	1977
456	105466	1.6	1977
457	105430	3	1964
458	105429	0	1964
459	105411	1	1964
460	105409	0	1964
461	118533	0	1975
462	105326	1	1973
463	105325	1.9	1973
464	105324	1.9	1973
465	105323	1.9	1973
466	105318	1.9	1973
467	105317	1.9	1973
468	105316	1.9	1973
469	118531	0	1975
470	105306	2	1971
471	105298	1.8	1974
472	105297	1.8	1974
473	105289	1.8	1974
474	110876	0	1975
475	105286	1.8	1974
476	105285	1.8	1974
477	105283	2.8	1961
478	105279	3	1974
479	105275	1.8	1974
480	105274	1.8	1974
481	105264	1.8	1974
482	105242	0.9	1988
483	105152	1.7	1975
484	105037	3.8	1951
485	104908	1.3	1982
486	104833	1.3	1981
487	104830	0	1981
488	104823	1.8	1974
489	104822	1.8	1974
490	104821	1.8	1974
491	104815	1.8	1974
492	104814	1.8	1974
493	108886	0	1974
494	104762	1.9	1972
495	104761	1.9	1972
496	108885	0	1974
497	108884	0	1974
498	104737	1.9	1973
499	104736	1.9	1973
500	104735	1.9	1973
501	104722	1.9	1973
502	108883	0	1974
503	104407	1	1952
504	108868	0	1974
505	108867	0	1974
506	104154	1.9	1972
507	104153	1.9	1972
508	104150	1.9	1972
509	104149	1.9	1972
510	104145	1.9	1972
511	104144	1.9	1972
512	104143	1.9	1972
513	104142	1.9	1972
514	104141	1.8	1974
515	104140	1.8	1974
516	108865	0	1974
517	105811	0	1974
518	105810	0	1974
519	104136	1.8	1974
520	104135	1.8	1974
521	104134	2	1933
522	104131	1.8	1974
523	104130	1.8	1974
524	105386	0	1974
525	105287	0	1974
526	105282	0	1974
527	105278	0	1974
528	105268	0	1974
529	105267	0	1974
530	105266	0	1974
531	104038	0	1972
532	104037	0	1972
533	104137	0	1974
534	104033	0	1972
535	104120	0	1974
536	103988	0	1988
537	103983	1.3	1982
538	103980	1.3	1982
539	103979	1.3	1982
540	103974	1.3	1982
541	103972	1.3	1982
542	103971	1.3	1982
543	103970	1.3	1982
544	103968	1.3	1982
545	103967	1	1986
546	103966	1	1986
547	103965	1	1986
548	103964	1	1986
549	103962	1	1986
550	103961	1	1986
551	103954	1	1986
552	103953	1	1986
553	103951	1	1986
554	103949	1	1986
555	103948	1	1986
556	103945	1	1986
557	103944	1	1986
558	103941	1	1986
559	103940	1	1986
560	103939	1	1986
561	103938	1	1986
562	103937	1	1986
563	103927	0	1988
564	103926	0	1988
565	103920	0	1988
566	103919	0	1988
567	103918	0	1988
568	103911	0	1988
569	103910	0	1988
570	103909	0	1988
571	103908	0	1988
572	103871	1.1	1985
573	103870	1.1	1985
574	103869	1.6	1977
575	103868	1.6	1977
576	103862	1.6	1977
577	103861	1.3	1982
578	103860	1.1	1985
579	103859	1.3	1982
580	103858	1.6	1977
581	103857	1.6	1977
582	103812	1.6	1977
583	103811	1.6	1977
584	103810	1.6	1977
585	103809	1.6	1977
586	103808	1.6	1977
587	103807	1.6	1977
588	103806	1.6	1977
589	103805	1.6	1977
590	103782	1.6	1977
591	103766	0	1993
592	103765	0	1991
593	103764	0	1993
594	103763	0.8	1991
595	103762	0.8	1991
596	103761	0.8	1991
597	103760	0.8	1991
598	103759	0	1993
599	103758	0	1993
600	103757	0	1993

200	CCTV Near-Term		
Count	Pipe ID	CCTV Score	Install Year
601	103751	0.8	1991
602	103750	0.8	1991
603	103749	0.8	1991
604	103748	0.8	1991
605	103747	0.8	1991
606	103746	0.8	1991
607	103745	0.8	1991
608	103744	0.8	1991
609	103743	0.8	1991
610	103735	0.5	1997
611	103693	0	1987
612	103664	0	1995
613	103663	0	1995
614	103661	0	1987
615	103660	0	1995
616	103428	0	1972
617	103427	0	1972
618	103424	0.7	1992
619	107303	0	1973
620	107302	0	1973
621	103335	0	1972
622	103334	0	1972
623	103333	1.9	1972
624	103332	1.9	1972
625	103329	1.9	1972
626	103328	1.9	1972
627	103327	1.9	1972
628	103326	0	1972
629	103325	0	1972
630	103324	1.9	1972
631	103322	0	1965
632	103321	0	1965
633	103320	0	1965
634	107301	0	1973
635	107278	0	1973
636	103315	0.7	1992
637	103290	0	1966
638	103288	0	1965
639	103287	0	1966
640	103286	0	1965
641	103285	2.5	1965
642	103284	2.5	1965
643	107274	0	1973
644	107273	0	1973
645	2000470	0	1972
646	107277	0	1972
647	107276	0	1972
648	107275	0	1972
649	105284	0	1972
650	103265	0	1965
651	103262	0.7	1992
652	103260	0	1965
653	103252	0	1965
654	103247	0.7	1993
655	103246	2.8	1961
656	103242	2.8	1961
657	103241	2.5	1961
658	106277	0	1971
659	105305	0	1971
660	105295	0	1971
661	105288	0	1971
662	101711	0	1971
663	101694	0	1971
664	107707	0	1970
665	103115	0	1987
666	103076	2	1990
667	103075	2	1988
668	103071	0.7	1994
669	106416	0	1968
670	103060	0.9	1988
671	106415	0	1968
672	106413	0	1968
673	103036	1.3	1981
674	103035	1.6	1977
675	103034	1.3	1981
676	103033	1.6	1977
677	106356	0	1968
678	103031	1.6	1977
679	102965	0	1977
680	102964	0	1977
681	102963	0	1977
682	106353	0	1968
683	106283	0	1968
684	106282	0	1968
685	106281	0	1968
686	105858	0	1967
687	105785	0	1967
688	106494	0	1966
689	103318	0	1965
690	103317	0	1965
691	103316	0	1965
692	103283	0	1965
693	102948	1	1982
694	102946	3	1982
695	103282	0	1965
696	103269	0	1965
697	103268	0	1965
698	103267	0	1965
699	102936	3	1982
700	103266	0	1965
701	100220	0	1965
702	100219	0	1965
703	100218	0	1965
704	102568	0.8	1991
705	102567	0.8	1991
706	102562	0.8	1991
707	102561	0.8	1991
708	102560	0.8	1991
709	102559	0.8	1991
710	102538	0.8	1991
711	102416	3.1	1958
712	102343	3.1	1958
713	102327	0	1993
714	102326	0	1993
715	102325	0	1993
716	102324	0	1993
717	102323	0	1993
718	102322	0	1993
719	102310	0	1993
720	102309	0	1993
721	102308	0.7	1993
722	102307	0	1993
723	102298	0	1987
724	102295	0	1985
725	102109	0	1987
726	102108	0	1987
727	102107	0	1987
728	102106	0	1987
729	102105	1	1987
730	102059	2.3	1952
731	102058	0	1952
732	102057	2	1952
733	102056	2	1952
734	102055	3	1952
735	100273	0	1963
736	101834	2.6	1964
737	101833	3.1	1958
738	101832	2.3	1967
739	101831	3.1	1958
740	101830	3.1	1958
741	101829	3.1	1958
742	101825	2.2	1969
743	101824	3	1959
744	101823	3	1959
745	101822	2.6	1964
746	101821	2.6	1964
747	101820	2.6	1964
748	101806	1.5	1953
749	101780	1.7	1953
750	101779	2.4	1966
751	101778	2.4	1966
752	101767	2	1950
753	101766	1	1951
754	101764	2.3	1967
755	101763	1.5	1953
756	101761	2	1953
757	101755	2	1953
758	101751	0	1958
759	101750	3.1	1958
760	101749	3.1	1958
761	101748	3.1	1958
762	101747	2.3	1967
763	101746	2.3	1967
764	101745	2.3	1967
765	101740	2.3	1967
766	101734	2.3	1967
767	101733	2.3	1967
768	101732	2.3	1967
769	108328	0	1962
770	108327	0	1962
771	108326	0	1962
772	101693	3.4	1955
773	101692	3.4	1955
774	101684	0	1960
775	101678	0	1960
776	101676	0	1960
777	101675	0	1960
778	101674	0	1960
779	101090	0	1962
780	101089	0	1962
781	101363	2.5	1965
782	101362	2.5	1965
783	101360	0	1965
784	101359	0	1965
785	118234	0	1961
786	101322	0	1974
787	101321	0	1952
788	101320	2.8	1952
789	101302	0	1974
790	101301	0	1952
791	101268	0.6	1995
792	101260	0.6	1995
793	101258	0.6	1995
794	101257	0.6	1995
795	101256	0.6	1995
796	101248	3.9	1950
797	101247	3.9	1950
798	101131	2.7	1963
799	101130	2.7	1963
800	101129	2.7	1963

119	CCTV Near-Term		
Count	Pipe ID	CCTV Score	Install Year
801	101123	2.3	1967
802	101121	2.3	1967
803	101120	3	1959
804	101119	3	1959
805	101118	3	1959
806	101117	3	1959
807	101116	2.3	1967
808	101115	2.3	1967
809	101114	2.3	1967
810	101113	3.1	1958
811	118543	0	1960
812	118542	0	1960
813	100867	0	1985
814	100775	0	1976
815	101686	0	1960
816	100388	0	1960
817	108303	0	1959
818	100751	0	1966
819	100750	0	1966
820	100748	0	1966
821	100746	0	1966
822	100745	0	1966
823	100742	0	1966
824	100739	2.5	1965
825	100738	2	1966
826	100737	0	1966
827	100736	2	1965
828	100735	2	1965
829	100734	2	1965
830	100730	2.5	1965
831	100727	3	1959
832	100726	2	1971
833	100721	2.7	1963
834	100720	2.7	1963
835	100719	2.7	1963
836	100663	0	1953
837	100662	2	1953
838	100656	0.7	1992
839	100651	0.7	1993
840	106607	0	1954
841	100756	0	1954
842	100640	0.7	1992
843	100638	0.7	1992
844	100637	1.9	1972
845	100636	1.9	1972
846	100555	1	1966
847	100489	1.5	1979
848	100755	0	1954
849	100754	0	1954
850	100753	0	1954
851	108312	0	1953
852	100483	2	1979
853	100481	1	1987
854	100478	1	1987
855	100477	1	1987
856	100476	1.5	1979
857	100475	1	1987
858	100471	1.5	1979
859	100470	1.5	1979
860	100467	0	1973
861	100436	1.5	1978
862	100435	1.5	1978
863	100434	1.5	1978
864	100433	1.5	1978
865	100432	1.5	1978
866	100431	1.5	1978
867	100430	2.4	1966
868	100426	2.4	1966
869	100425	1.5	1978
870	100416	2.9	1960
871	100773	0	1953
872	100772	0	1953
873	100771	0	1953
874	100392	0.8	1990
875	100391	0.8	1990
876	100390	0.8	1990
877	100752	0	1953
878	100387	2.8	1960
879	106606	0	1951
880	100357	3.9	1950
881	100354	2.7	1963
882	100353	2.7	1963
883	119015	0	1947
884	104139	0	1933
885	100340	3.6	1953
886	100280	2.2	1968
887	100278	3.9	1950
888	100277	3.9	1950
889	100276	2.7	1963
890	100275	3.9	1950
891	100274	2.7	1963
892	104138	0	1933
893	100272	2.7	1963
894	100271	3.9	1950
895	100268	2.7	1963
896	100267	2.7	1963
897	100266	2.7	1963
898	100265	2.7	1963
899	100264	2.7	1963
900	100208	2.4	1966
901	100207	2.4	1966
902	100195	0	1966
903	100194	0	1966
904	100192	0	1966
905	100191	0	1966
906	100155	2	1953
907	100148	0	1955
908	100147	0	1955
909	100122	3.3	1955
910	100112	3.4	1955
911	100097	2	1953
912	100096	0	1953
913	100043	3	1961
914	100042	3	1961
915	100037	0	1961
916	100036	0	1961
917	100035	0	1961
918	100034	0	1961
919	100033	0	1961

Total No. Of Pipes for CCTV Medium-Term = 705

200	CCTV Medium-Term		
Count	Pipe ID	CCTV Score	Install Year
1	2135141	0.1	2011
2	2126349	0	2016
3	2126347	0	2016
4	2126346	0	2016
5	2126337	0	2016
6	2117320	0	2016
7	2117319	0	2016
8	2117285	0.1	2015
9	2117282	0.1	2015
10	2117281	0.1	2015
11	2117280	0.1	2015
12	2117279	0.1	2015
13	2117278	0.1	2015
14	2117318	0	2016
15	2113381	0	2016
16	2113379	0	2016
17	2113377	0	2016
18	2113376	0	2016
19	2113374	0	2016
20	2113368	0	2016
21	2113303	0.1	2015
22	2113302	0.1	2015
23	2113300	0.1	2015
24	2105641	0.1	2012
25	2105640	0.1	2012
26	2105631	0.1	2012
27	2105627	0.1	2012
28	2104759	0.1	2013
29	2104747	0.1	2013
30	2104737	0.1	2013
31	2104736	0.1	2013
32	2104735	0.1	2013
33	2104734	0.1	2013
34	2104733	0.1	2013
35	106280	0	2016
36	2102107	0.1	2013
37	2102104	0.1	2013
38	2102101	0.1	2013
39	2102100	0.1	2013
40	2102099	0.1	2013
41	2101939	0.3	2004
42	2101938	0.3	2004
43	2101918	0.3	2004
44	2099539	0.1	2015
45	2099538	0.1	2015
46	2098785	0.2	2006
47	2098784	0.2	2006
48	2098783	0.2	2006
49	2097084	0.3	2005
50	2097083	0.3	2005
51	2097081	0.3	2005
52	2097080	0.3	2005
53	2097078	0.3	2005
54	2097067	0.3	2005
55	2097062	0.3	2005
56	2097050	0.3	2005
57	2097048	0.3	2005
58	2094240	0.1	2014
59	2094239	0.1	2014
60	2094238	0.1	2014
61	2094237	0.1	2014
62	2094236	0.1	2014
63	2094235	0.1	2014
64	2094234	0.1	2014
65	2094233	0.1	2014
66	2094232	0.1	2014
67	2094231	0.1	2014
68	2094230	0.1	2014
69	2093999	0.1	2011
70	2093997	0.1	2011
71	2092869	0.1	2014
72	2092868	0.1	2014
73	2092867	0.1	2014
74	2092866	0.1	2014
75	2092865	0.1	2014
76	2092864	0.1	2014
77	2092863	0.1	2014
78	2092862	0.1	2014
79	2092861	0.1	2014
80	2092860	0.1	2014
81	2092859	0.1	2014
82	2092858	0.1	2014
83	2091445	0.3	2004
84	2091443	0.3	2004
85	2091441	0.3	2004
86	2091439	0.3	2004
87	2090883	0.2	2009
88	2090881	0.2	2009
89	2090879	0.2	2009
90	2090802	0.2	2009
91	2090801	0.2	2009
92	2090799	0.2	2009
93	2090796	0.2	2009
94	2090795	0.2	2009
95	2090793	0.2	2009
96	2090792	0.2	2009
97	2090790	0.2	2009
98	2090789	0.2	2009
99	2090787	0.2	2009
100	2090786	0.2	2009
101	2090783	0.2	2009
102	2090782	0.2	2009
103	2090777	0.2	2009
104	2090776	0.2	2009
105	2090774	0.2	2009
106	2090772	0.2	2009
107	2090770	0.2	2009
108	2090769	0.2	2009
109	2090766	0.2	2009
110	2090764	0.2	2009
111	2090761	0.2	2009
112	2090760	0.2	2009
113	2090759	0.2	2009
114	2090758	0.2	2009
115	2089462	0.1	2012
116	2089461	0.1	2012
117	2089460	0.1	2012
118	2089459	0.1	2012
119	2089458	0.1	2012
120	2088379	0.1	2014
121	2088377	0.1	2014
122	2084435	0.1	2011
123	2084434	0.1	2011
124	2084433	0.1	2011
125	2084432	0.1	2011
126	2084427	0.1	2011
127	2083765	0.2	2006
128	2083764	0.2	2006
129	2083730	0.2	2006
130	2083729	0.2	2006
131	2083728	0.2	2006
132	2083727	0.2	2006
133	2083726	0.2	2006
134	2083725	0.2	2006
135	2083724	0.2	2006
136	2083723	0.2	2006
137	2083722	0.2	2006
138	2083721	0.2	2006
139	2083720	0.2	2006
140	2083101	0.1	2012
141	2083078	0.1	2012
142	2083038	0.1	2012
143	2083037	0.1	2012
144	2083030	0.1	2012
145	2083026	0.1	2012
146	2083025	0.1	2012
147	2083021	0.1	2012
148	2083019	0.1	2012
149	2082999	0.1	2012
150	2082978	0.1	2012
151	2082938	0.1	2012
152	2082925	0.1	2012
153	2082922	0.1	2012
154	2082901	0.1	2012
155	2082886	0.1	2012
156	2082885	0.1	2012
157	2082883	0.1	2012
158	2046044	0.2	2006
159	2028377	0.1	2012
160	2027930	0	2012
161	2021289	0	1999
162	2020956	0	2002
163	2020955	0	2002
164	2020952	0	2002
165	2020590	0.2	2007
166	2017067	0.1	2012
167	2017066	0.1	2012
168	2017064	0.1	2012
169	2011327	0.1	2011
170	2011324	0.1	2011
171	2011323	0.1	2011
172	2011322	0.1	2011
173	2011321	0.1	2011
174	2011320	0.1	2011
175	2011319	0.1	2011
176	2011313	0.1	2011
177	2011310	0.1	2011
178	2002589	0.2	2009
179	2002564	0.1	2010
180	2002561	0.1	2010
181	2002559	0.1	2010
182	2002557	0.1	2010
183	2001863	0.2	2008
184	2001763	0.3	2005
185	2001011	0	2009
186	2001721	0.1	2010
187	2001716	0.1	2010
188	2001715	0.1	2010
189	2001010	0	2009
190	2001005	0	2009
191	2001004	0	2009
192	2001534	0.2	2007
193	2001532	0.2	2007
194	2001529	0.2	2007
195	2001527	0.2	2007
196	2001440	0.3	2004
197	2001426	0.3	2004
198	2001425	0.3	2004
199	2001424	0.3	2004
200	2001419	0.3	2004

200	CCTV Medium-Term		
Count	Pipe ID	CCTV Score	Install Year
201	2001415	0.3	2004
202	2001414	0.3	2004
203	2001412	0.3	2004
204	2001003	0	2009
205	2001002	0	2009
206	2000988	0	2009
207	2000987	0	2009
208	2000955	0	2009
209	2001258	0.3	2005
210	2000953	0	2009
211	2001171	0.4	2002
212	2001167	0.4	2002
213	2001161	0.4	2002
214	2001160	0.4	2002
215	2001157	0.4	2002
216	2001130	0.3	2003
217	2001129	0.3	2006
218	2001125	0.3	2003
219	2001122	0.4	2002
220	2001120	0.4	2002
221	2001119	0.4	2002
222	2001114	0.4	2002
223	2001111	0.4	2002
224	2001108	0.3	2003
225	2001107	0.3	2003
226	2001104	0.3	2003
227	2001102	0.4	2002
228	2001101	0.4	2002
229	2001100	0.4	2002
230	2001099	0.4	2002
231	2001098	0.4	2002
232	2001087	0.4	2002
233	2001086	0.4	2002
234	2001076	0.4	2002
235	2001013	0.2	2009
236	2000984	0	2007
237	2000983	0	2007
238	2000982	0	2007
239	2000981	0	2007
240	104755	0	2006
241	2000956	0.2	2009
242	2000954	0.2	2007
243	2000952	0.2	2009
244	2000796	0.3	2005
245	2000752	0.3	2005
246	2000750	0.3	2005
247	2000749	0.3	2005
248	2000748	0.3	2005
249	2000747	0.3	2005
250	2000690	0.2	2009
251	2000689	0.2	2009
252	2000688	0.2	2009
253	2000687	0.2	2009
254	2000686	0.2	2009
255	2000618	0.2	2008
256	2000568	0.2	2008
257	2000565	0.2	2009
258	106462	0	2005
259	106461	0	2005
260	2000323	0.2	2006
261	2000322	0.2	2006
262	2000321	0.2	2006
263	2000320	0.2	2006
264	2000222	0.2	2008
265	2000029	0.3	2005
266	2000028	0.3	2005
267	2000026	0.3	2005
268	2000017	0.2	2006
269	2000015	0.2	2006
270	2000013	0.2	2006
271	2000011	0.2	2006
272	2000009	0.2	2006
273	121287	0.2	2008
274	121286	0.2	2008
275	121285	0.1	2010
276	121284	0.1	2010
277	121283	0.1	2010
278	121282	0.1	2010
279	121217	0.2	2006
280	121215	0.2	2006
281	121213	0.2	2006
282	121016	0.2	2006
283	121015	0.2	2006
284	121014	0.2	2006
285	121013	0.2	2006
286	121012	0.2	2007
287	121011	0.2	2007
288	121010	0.2	2006
289	121009	0.2	2007
290	121008	0.2	2006
291	121007	0.2	2006
292	121006	0.2	2007
293	121005	0.2	2007
294	121004	0.2	2006
295	121003	0.2	2006
296	121000	0.2	2006
297	120999	0.2	2006
298	120996	0.2	2006
299	120995	0.2	2006
300	120994	0.2	2006
301	120993	0.2	2006
302	120992	0.2	2006
303	120960	0.2	2006
304	120959	0.2	2006
305	120942	0.2	2006
306	120853	0.1	2011
307	120787	0.3	2004
308	120785	0.3	2004
309	120779	0.3	2004
310	120777	0.3	2004
311	120434	0.3	2003
312	120433	0.3	2003
313	119994	0.3	2004
314	119992	0.3	2003
315	119990	0.3	2003
316	119987	0.3	2003
317	119986	0.3	2003
318	119961	0.3	2003
319	119959	0.3	2003
320	119931	0.2	2007
321	119692	0.3	2004
322	119690	0.3	2004
323	119689	0.3	2004
324	119687	0.3	2004
325	119686	0.3	2004
326	119683	0.3	2004
327	119680	0.3	2004
328	119676	0.3	2004
329	119666	0.3	2005
330	119662	0.3	2005
331	119656	0.3	2005
332	119655	0.3	2005
333	119649	0.3	2005
334	119646	0.3	2005
335	119643	0.3	2005
336	119642	0.3	2005
337	119641	0.3	2005
338	119640	0.3	2005
339	119637	0.3	2005
340	119574	0.3	2004
341	119571	0.3	2004
342	119570	0.3	2004
343	119545	0.4	2002
344	119540	0.4	2002
345	119530	0.4	2002
346	119529	0.4	2002
347	119528	0.4	2002
348	119526	0.3	2004
349	119525	0.4	2002
350	119524	0.4	2002
351	119523	0.4	2002
352	119400	0.4	2002
353	119399	0.4	2002
354	119398	0.4	2002
355	119396	0.4	2002
356	119395	0.4	2002
357	119394	0.4	2002
358	119392	0.4	2002
359	119380	0.4	2002
360	119379	0.4	2002
361	119378	0.4	2002
362	119377	0.4	2002
363	119376	0.4	2002
364	119375	0.4	2002
365	119374	0.4	2002
366	119373	0.4	2002
367	119372	0.4	2002
368	119370	0.4	2002
369	119369	0.4	2002
370	119121	0.1	2011
371	119115	0.1	2011
372	119114	0.1	2011
373	119022	3	1971
374	118923	0.4	2000
375	118030	0	2001
376	118905	0.4	2000
377	118806	0.4	2001
378	118805	0.4	2001
379	118804	0.4	2001
380	118803	0.4	2001
381	118802	0.4	2001
382	118741	0.4	2000
383	118740	0.4	2000
384	118592	0	2000
385	118591	0	2000
386	118590	0	2000
387	2012068	0	1997
388	118853	0	1997
389	118852	0	1997
390	118850	0	1997
391	118689	0	1997
392	118588	0.5	1999
393	118583	0.5	1999
394	118581	0.4	2000
395	118580	0.5	1998
396	118688	0	1997
397	118887	0	1997
398	118884	0	1997
399	118883	0	1997
400	118536	1	1940

200	CCTV Medium-Term		
Count	Pipe ID	CCTV Score	Install Year
401	118374	0	1997
402	118373	0	1997
403	118498	0.3	2004
404	118495	0.3	2004
405	118494	0.4	2000
406	118493	0.4	2000
407	118492	0.4	2000
408	118491	0.4	2000
409	118490	0.4	2000
410	118478	0.4	2000
411	118477	0.4	2000
412	118476	0.4	2000
413	118475	0.4	2000
414	118474	0.4	2000
415	118473	0.4	2000
416	118472	0.4	2000
417	118471	0.4	2000
418	118470	0.4	2000
419	118469	0.4	2000
420	118468	0.4	2000
421	118466	0.4	2000
422	118463	0.4	2000
423	118462	0.4	2000
424	118461	0.5	1998
425	118460	0.4	2000
426	118458	0.4	2000
427	118426	0.4	2000
428	118421	0.4	2000
429	118420	0.4	2000
430	118372	0	1997
431	118371	0	1997
432	104129	0	1997
433	118298	0	1987
434	2001624	0	1995
435	118210	0	1952
436	118209	0	1952
437	2001622	0	1995
438	114429	0	1991
439	114422	2	1980
440	110907	0.2	2009
441	100652	0	1993
442	108386	0	1992
443	108380	0	1992
444	108379	0	1992
445	108378	0	1992
446	110846	2	1992
447	108377	0	1992
448	108373	0	1992
449	107728	0	1992
450	107727	0	1992
451	107726	0	1992
452	107725	0	1992
453	107724	0	1992
454	107723	0	1992
455	107721	0	1992
456	107720	0	1992
457	109884	0	1992
458	105883	0	1992
459	110970	0	1991
460	110511	0	1999
461	108941	0.3	2005
462	108161	0	1987
463	108160	0	1987
464	108159	0	1987
465	108158	0	1986
466	108166	0	1986
467	108165	0	1986
468	103995	0	1986
469	108387	1	1992
470	101863	3	1985
471	101862	3	1985
472	108376	1	1992
473	108375	0	1992
474	108334	2	1985
475	108318	3	1967
476	108316	3	1995
477	108194	2	1986
478	108193	2	1986
479	108176	2	1986
480	108175	2	1986
481	108174	2	1986
482	118798	0	1982
483	108157	2	1987
484	108156	2	1987
485	108155	2	1987
486	108154	2	1987
487	108150	2	1987
488	108149	2	1987
489	108148	2	1987
490	108147	0	1991
491	108145	2	1987
492	108144	2	1987
493	108143	2	1990
494	108142	2	1990
495	108141	2	1991
496	108140	2	1991
497	108139	2	1991
498	108136	2	1991
499	108135	2	1991
500	108133	2	1991
501	108132	2	1991
502	108131	0	1991
503	108130	0	1991
504	108129	2	1991
505	108102	0	1991
506	108101	0	1991
507	108100	2	1991
508	108099	0	1991
509	104034	0	1982
510	103999	0	1982
511	103992	0	1982
512	103991	0	1982
513	103990	0	1982
514	118329	0	1980
515	110967	0	1980
516	110966	0	1980
517	110962	0	1980
518	110947	0	1980
519	107607	2	1980
520	107606	2	1980
521	107556	2	1980
522	107553	1	1980
523	107369	1	1975
524	107350	2	1975
525	107349	2	1975
526	108040	0	1980
527	108039	0	1980
528	108035	0	1980
529	107305	2	1971
530	107304	2	1971
531	108022	0	1980
532	107555	0	1980
533	107554	0	1980
534	107552	0	1980
535	107298	2	1971
536	106033	0	1980
537	107238	2	1973
538	107233	2	1973
539	107227	3	1971
540	107226	2	1971
541	107225	1.7	1971
542	107223	2	1973
543	107222	2	1971
544	107221	2	1971
545	107217	0	1971
546	107216	0	1971
547	107215	0	1971
548	107214	3	1972
549	107209	0	1971
550	107207	0	1971
551	107206	0	1971
552	107205	0	1971
553	107204	0	1972
554	110560	0	1979
555	106936	2.7	1932
556	106817	2	1995
557	106816	2	1995
558	106807	0.1	2010
559	106517	0	2005
560	106516	1.9	2005
561	110917	0	1978
562	110916	0	1978
563	110915	0	1978
564	105852	0	1978
565	105851	0	1978
566	106405	2	2016
567	106040	2.1	2005
568	106032	0	1992
569	105934	0	1969
570	106928	0	1969
571	105847	0	1954
572	105824	3	1947
573	108003	0	1976
574	107612	0	1976
575	107611	0	1976
576	107610	0	1976
577	105802	0	1969
578	107585	0	1976
579	105322	0.2	2007
580	105313	2.9	1929
581	110953	0	1975
582	110951	0	1975
583	110922	0	1975
584	107381	0	1975
585	107360	0	1975
586	107358	0	1975
587	105273	0.1	2011
588	105272	0.1	2011
589	105271	0.1	2011
590	105270	0.1	2011
591	107357	0	1975
592	107354	0	1975
593	107348	0	1975
594	107347	0	1975
595	106260	0.3	2005
596	105199	3.7	1923
597	105151	1	1975
598	105150	0	1975
599	105148	0	1975
600	105147	2	1985

105	CCTV Medium-Term		
Count	Pipe ID	CCTV Score	Install Year
601	105144	0.3	2004
602	105141	1	1938
603	105040	3	1952
604	105039	2	1952
605	104829	2	1996
606	104824	2.5	1927
607	104812	0.2	2006
608	104806	2	1927
609	104804	1.3	1940
610	104803	1	1940
611	104446	1	1994
612	104445	0	1994
613	104437	0	1996
614	104436	0	1996
615	104430	0	1996
616	104426	0	1991
617	104421	0	1991
618	104418	0	1993
619	104417	0	1993
620	104412	0	1992
621	104399	2.3	1952
622	104280	0	1988
623	104262	0	1988
624	104259	0	1988
625	104258	0	1988
626	104124	0	1974
627	104000	2	1986
628	104123	0	1974
629	104122	0	1974
630	103994	2	1982
631	103993	2	1982
632	104121	0	1974
633	2099059	0	1973
634	103985	2	1982
635	107331	0	1973
636	107317	0	1973
637	107316	0	1973
638	107315	0	1973
639	107298	0	1973
640	103291	0	1966
641	105850	0	1973
642	104559	0	1973
643	104119	0	1973
644	108306	0	1969
645	107873	0	1968
646	107869	0	1968
647	107868	0	1968
648	107862	0	1968
649	107861	0	1968
650	107860	0	1968
651	107859	0	1968
652	101715	0	1964
653	100650	0	1963
654	100361	0	1963
655	100352	0	1963
656	102297	0	1988
657	102296	0	1987
658	100351	0	1963
659	102110	0	1987
660	100347	0	1963
661	107831	0	1962
662	107830	0	1962
663	107829	0	1962
664	107828	0	1962
665	107827	0	1962
666	107826	0	1962
667	107825	0	1962
668	107771	0	1962
669	107733	0	1961
670	107732	0	1961
671	107731	0	1961
672	101319	0.3	2003
673	101305	3	1940
674	101261	0	1932
675	101128	3	1963
676	101127	3	1963
677	101126	3	1967
678	101125	0.2	2007
679	101124	3	1967
680	101122	3	1967
681	107772	0	1960
682	107765	0	1960
683	107764	0	1960
684	100695	0	1960
685	100415	0	1960
686	100723	0.5	1958
687	102357	0	1958
688	100690	0.1	2011
689	100689	0.1	2011
690	100658	0.3	2005
691	102356	0	1958
692	100649	2	1963
693	100635	2	1993
694	100484	0.4	2001
695	104400	0	1952
696	100356	1.5	1950
697	107729	0	1948
698	100349	0	1952
699	100525	0	1947
700	105823	0	1947
701	105822	0	1947
702	100344	2	1948
703	105307	0	1929
704	104764	0	1927
705	104760	0	1927

Total No. Of Pipes for CCTV Long-Term = 239

239	CCTV Long-Term		
Count	Pipe ID	CCTV Score	Install Year
1	2139312	0	2021
2	2139311	0	2021
3	2139310	0	2021
4	2139297	0	2021
5	2139293	0	2021
6	2139292	0	2021
7	2134598	0	2020
8	2134587	0	2020
9	2134586	0	2020
10	2134684	0	2020
11	2134683	0	2020
12	2134682	0	2020
13	2134681	0	2020
14	2134430	0	2020
15	2134424	0	2020
16	2133607	0	2017
17	2133593	0	2017
18	2133592	0	2017
19	2133591	0	2017
20	2133590	0	2017
21	2133589	0	2017
22	2133587	0	2017
23	2133586	0	2017
24	2133574	0	2017
25	2133556	0	2017
26	2133555	0	2017
27	2132871	0	2020
28	2132870	0	2020
29	2132867	0	2020
30	2132866	0	2020
31	2132865	0	2020
32	2132864	0	2020
33	2132863	0	2020
34	2132862	0	2020
35	2132861	0	2020
36	2132860	0	2020
37	2132859	0	2020
38	2129918	0	2019
39	2129917	0	2019
40	2129916	0	2019
41	2129899	0	2019
42	2129898	0	2019
43	2129897	0	2019
44	2129896	0	2019
45	2129893	0	2019
46	2129894	0	2019
47	2129891	0	2019
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50	2129887	0	2019
51	2129886	0	2019
52	2129885	0	2019
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56	2129881	0	2019
57	2129880	0	2019
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82	2129374	0	2019
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91	2129919	0	2018
92	2129878	0	2018
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100	2129997	0	2018
101	2125261	0	2018
102	2125260	0	2018
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110	2125200	0	2018
111	2125198	0	2018
112	2121907	0	2018
113	2121906	0	2018
114	2121905	0	2018
115	2121904	0	2018
116	2121903	0	2018
117	2121902	0	2018
118	2121901	0	2018
119	2121900	0	2018
120	2121899	0	2018
121	2121898	0	2018
122	2119100	0	2018
123	2128569	0	2017
124	2126564	0	2017
125	2124696	0	2017
126	2124695	0	2017
127	2119446	0	2017
128	2119443	0	2017
129	2119442	0	2017
130	2124856	0	2017
131	2119437	0	2017
132	2119436	0	2017
133	2119434	0	2017
134	2119436	0	2017
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136	2117138	0	2017
137	2108805	0	2016
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141	2102250	0	2015
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146	2102242	0	2015
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149	2102245	0	2015
150	2091731	0	2013
151	2091730	0	2013
152	2091728	0	2013
153	119923	0	2010
154	2007269	0	2004
155	2007268	0	2004
156	2002133	0	2010
157	2002130	0	2010
158	2002128	0	2010
159	2000351	0	2008
160	2000349	0	2008
161	2000347	0	2008
162	2000345	0	2008
163	2000343	0	2008
164	2000341	0	2008
165	2001308	0	2005
166	2001294	0	2005
167	2001291	0	2005
168	2001287	0	2005
169	2001285	0	2005
170	2000753	2	2008
171	2001254	0	2005
172	2001253	0	2005
173	2000897	0	2005
174	2000733	0	2005
175	2000730	0	2005
176	2000668	0	2009
177	2000667	0	2009
178	2000664	0	2009
179	2000646	0	2009
180	2000176	2	2010
181	2000723	0	2008
182	2002368	0	2008
183	2000364	0	2008
184	2000357	0	2008
185	2000356	0	2008
186	2000353	0	2008
187	2000729	0	2005
188	2000721	0	2005
189	181712	0	2005
190	180646	0	2005
191	119594	0	2000
192	119592	0	2000
193	119591	0	2000
194	119590	2	2000
195	119588	0	2000
196	119587	0	2000
197	119585	0	2000
198	119584	2	2000
199	119583	0	2000
200	119580	0	2000
201	119578	0	2000
202	180548	0	2005
203	180546	0	2005
204	118932	0	2000
205	118931	0	2000
206	118930	0	2000
207	118929	2	2000
208	118927	0	2000
209	118925	0	2000
210	180543	0	2005
211	118922	0	2000
212	118924	0	2000
213	118921	0	2000
214	118920	0	2000
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219	118912	0	2000
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221	118908	0	2000
222	118907	0	2000
223	118906	0	2000
224	118737	0	2000
225	118736	0	2000
226	118735	0	2000
227	118734	0	2000
228	118733	0	2000
229	118677	0	2000
230	118673	0	2000
231	118691	0	1999
232	118213	0	2005
233	118212	0	2005
234	118026	0	2003
235	115919	2.5	2010
236	104267	0	2004
237	101231	0	2000
238	100643	2	2005
239	100250	0	2005

APPENDIX D – CAPITAL PROJECTS, AND DATA ACQUISITION & MANAGEMENT PROGRAMS COSTING

City of Kitchener Integrated Sanitary Master Plan
Project Recommendations

Rate of Inflation Utilized 5%

Capital Projects

Annual amounts adjusted for inflation

	Description		Asset ID	Project Type	Length	Estimated Opinion of Probable Construction Cost (Base Year 2022)	Contingency Allowance (30%)	Engineering Allowance (20%)	City Staff Time Allowance (5%)	Total Cost	Recommended Budgetary Estimate	Comments	Priority	2024	2025	2026	2027
Short Term Projects (2024 - 2027)																	
ST1	Homer Watson	Alt A - Replacement of 7 lengths of sewer on Homer Watson due to capacity, replacement of 2 lengths of sewer on comm. property due to capacity/condition, replacement of 7 lengths of sewer on Alpine due to capacity/condition, replacement of 2 lengths of sewer on Flint due to capacity, replacement of 1 length of sewer on Kingswood due to condition.	107139, 107140, 107126, 107122, 107123, 107162, 107163, 107164, 107165, 107166, 107125, 118006, 107125, 118274, 2119959, 107124, 2119718, 107136	Capacity / Condition	1067	$ 2,445,443	$ 733,633	$ 635,815	$ 158,954	$ 3,973,845	$ 3,974,000		3	$ -	$ -	$ 4,830,422	$ -
ST2	Upper Schneider - Sandrock	Replacement of 3 lengths of sewer - upsizing from 675mm dia to 750mm dia	108887, 108888, 106767	Capacity	222	$ 1,448,000	$ 434,400	$ 376,480	$ 94,120	$ 2,353,000	$ 2,353,000		4	$ -	$ -	$ -	$ 3,001,091
ST3	Shirley SPS	Increase PS to 378 L/s firm capacity - project involves addition of pumps to accomodate higher flows		Capacity		$ 285,760	$ 85,728	$ 74,298	$ 18,574	$ 464,360	$ -	Upgrade to be paid for by Township of Woolwich					
ST4	Moore Ave SPS Decommissioning	Decommissioning of existing pumping station and extension of sewer to connect to existing sanitary sewer outlet at Union Street		Condition	400	$ 1,270,650	$ 381,195	$ 330,369	$ 82,592	$ 2,064,806	$ 2,065,000		1	$ 2,276,663	$ -	$ -	$ -
ST5	Apple Tree SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 157,985			$ 7,899	$ 165,884	$ 166,000		2	$ -	$ 192,166	$ -	$ -
ST6	Bancroft SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 11,673			$ 584	$ 12,257	$ 12,000		2	$ -	$ 13,892	$ -	$ -
ST7	Carson SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 11,673			$ 584	$ 12,257	$ 12,000		2	$ -	$ 13,892	$ -	$ -
ST8	Chandos SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 283,778			$ 14,189	$ 297,967	$ 298,000		3	$ -	$ -	$ 362,221	$ -
ST9	Conestoga College SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 157,985			$ 7,899	$ 165,884	$ 166,000		2	$ -	$ 192,166	$ -	$ -
ST10	Falconridge SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 299,308			$ 14,965	$ 314,273	$ 314,000		3	$ -	$ -	$ 381,669	$ -
ST11	King Street SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 88,203			$ 4,410	$ 92,614	$ 93,000		1	$ 102,533	$ -	$ -	$ -
ST12	New Dundee SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 11,673			$ 584	$ 12,257	$ 12,000		2	$ -	$ 13,892	$ -	$ -
ST13	Oxford SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 124,839			$ 6,242	$ 131,081	$ 131,000		2	$ -	$ 151,649	$ -	$ -
ST14	Patricia SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 72,332			$ 3,617	$ 75,948	$ 76,000		3	$ -	$ -	$ 92,378	$ -
ST15	River Birch SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 157,985			$ 7,899	$ 165,884	$ 166,000		4	$ -	$ -	$ -	$ 211,863
ST16	Springmount SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 11,673			$ 584	$ 12,257	$ 12,000		2	$ -	$ 13,892	$ -	$ -
ST17	Stoke SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 33,801			$ 1,690	$ 35,491	$ 35,000		4	$ -	$ -	$ -	$ 44,670
ST18	Victoria SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 11,673			$ 584	$ 12,257	$ 12,000		1	$ 13,230	$ -	$ -	$ -
ST19	Woolner SPS	Scada Upgrades Due to NFPA Requirements		Condition		$ 164,684			$ 8,234	$ 172,918	$ 173,000		2	$ -	$ 200,269	$ -	$ -
ST20	All Pumping Stations	Recommended from Cond. Assessment Reports		Condition						$ 3,902,008	$ 664,000	Budget adjusted from Condition Assessment Reports per City direction		$ 18,690	$ 164,731	$ 172,968	$ 181,616
ST21	Vanier	Recommended based on CCTV score	118182	Condition		$ 267,000			$ 13,350	$ 280,350	$ 280,400		2	$ -	$ 324,598	$ -	$ -
ST22	Westcrest	Recommended based on CCTV score	110504	Condition		$ 322,000			$ 16,100	$ 338,100	$ 338,100		2	$ -	$ 391,393	$ -	$ -
ST23	Parkside	Recommended based on CCTV score	109889	Condition		$ 279,000			$ 13,950	$ 292,950	$ 293,000		2	$ -	$ 339,184	$ -	$ -
ST24	Ottawa	Recommended based on CCTV score	101611, 101612, 101613, 101365, 101366, 101367, 101368, 101335, 101339, 101340, 101341, 101342, 101350, 101351, 101352, 101846, 101850, 101851, 101852	Condition		$ 2,747,000			$ 137,350	$ 2,884,350	$ 2,884,400		1	$ 3,180,051	$ -	$ -	$ -
ST25	Greenbrook Drive	Recommended based on CCTV score	108404, 108513	Condition		$ 595,000			$ 29,750	$ 624,750	$ 624,800		1	$ 688,842	$ -	$ -	$ -
ST26	Greenbrook Drive	Recommended based on CCTV score	107730	Condition		$ 336,000			$ 16,800	$ 352,800	$ 352,800		1	$ 388,962	$ -	$ -	$ -
ST27	Belmont	Recommended based on CCTV score	105256	Condition		$ 395,000			$ 19,750	$ 414,750	$ 414,800		1	$ 457,317	$ -	$ -	$ -
ST28	Centreville	Recommended based on CCTV score	100233	Condition		$ 646,000			$ 32,300	$ 678,300	$ 678,300		1	$ -	$ 785,217	$ -	$ -
ST29	Richmond	Recommended based on CCTV score	2002189	Condition		$ 247,000			$ 12,350	$ 259,350	$ 259,400		4	$ -	$ -	$ 315,302	$ -
ST30	Huck	Recommended based on CCTV score	119495	Condition		$ 297,000			$ 14,850	$ 311,850	$ 311,900		4	$ -	$ -	$ -	$ 396,072
ST31	Hathbrook	Recommended based on CCTV score	119059	Condition		$ 303,000			$ 15,150	$ 318,150	$ 318,200		2	$ -	$ 368,356	$ -	$ -
ST32	Deer Ridge	Recommended based on CCTV score	118447	Condition		$ 579,000			$ 28,950	$ 607,950	$ 608,000		4	$ -	$ -	$ -	$ 775,979
ST33	Woolwich	Recommended based on CCTV score	110889	Condition		$ 486,000			$ 24,300	$ 510,300	$ 510,300		2	$ -	$ 590,756	$ -	$ -
ST34	Northmanor	Recommended based on CCTV score	110709	Condition		$ 336,000			$ 16,800	$ 352,800	$ 352,800		4	$ -	$ -	$ -	$ 450,272
ST35	Windward	Recommended based on CCTV score	110610	Condition		$ 425,000			$ 21,250	$ 446,250	$ 446,300		1	$ -	$ -	$ 542,480	$ -
ST36	Westforest	Recommended based on CCTV score	110528	Condition		$ 461,000			$ 23,050	$ 484,050	$ 484,100		4	$ -	$ -	$ -	$ 617,848
ST37	Dawn Ridge	Recommended based on CCTV score	110522	Condition		$ 406,000			$ 20,300	$ 426,300	$ 426,300		4	$ -	$ -	$ -	$ 544,079
ST38	Mariah	Recommended based on CCTV score	108258	Condition		$ 216,000			$ 10,800	$ 226,800	$ 226,800		4	$ -	$ -	$ -	$ 289,461
ST39	Hathbrook	Recommended based on CCTV score	108216, 108203	Condition		$ 679,000			$ 33,950	$ 712,950	$ 713,000		4	$ -	$ -	$ -	$ 909,989
ST40	Block Line	Recommended based on CCTV score	108196	Condition		$ 418,000			$ 20,900	$ 438,900	$ 438,900		2	$ -	$ 508,082	$ -	$ -
ST41	Ristau	Recommended based on CCTV score	108056	Condition		$ 557,000			$ 27,850	$ 584,850	$ 584,900		2	$ -	$ 677,095	$ -	$ -
ST42	Ottawa St	Recommended based on CCTV score	107218	Condition		$ 406,000			$ 20,300	$ 426,300	$ 426,300		4	$ -	$ -	$ -	$ 544,079
ST43	Conestoga Parkway	Recommended based on CCTV score	107094	Condition		$ 781,000			$ 39,050	$ 820,050	$ 820,100		4	$ -	$ -	$ -	$ 1,046,679
ST44	Bedford	Recommended based on CCTV score	106954, 106955	Condition		$ 341,000			$ 17,050	$ 358,050	$ 358,100		1	$ 394,805	$ -	$ -	$ -
ST45	Spring Valley SPS	Recommended based on CCTV score	105843	Condition		$ 322,000			$ 16,100	$ 338,100	$ 338,100		1	$ -	$ 391,393	$ -	$ -
ST46	Cameron	Recommended based on CCTV score	104745	Condition		$ 491,000			$ 24,550	$ 515,550	$ 515,600		2	$ -	$ 596,871	$ -	$ -
ST47	Braithwait	Recommended based on CCTV score	104435	Condition		$ 252,000			$ 12,600	$ 264,600	$ 264,600		4	$ -	$ -	$ -	$ 337,704
ST48	Mcleod	Recommended based on CCTV score	103960	Condition		$ 241,000			$ 12,050	$ 253,050	$ 253,100		2	$ -	$ 292,995	$ -	$ -
ST49	Gateway Park	Recommended based on CCTV score	103769, 102270, 103771	Condition		$ 1,442,000			$ 72,100	$ 1,514,100	$ 1,515,100		1	$ 1,692,448	$ -	$ -	$ -
ST50	Brimbal	Recommended based on CCTV score	102507	Condition		$ 308,000			$ 15,400	$ 323,400	$ 323,400		4	$ -	$ -	$ -	$ 412,749
ST51	Denlow	Recommended based on CCTV score	102499	Condition		$ 301,000			$ 15,050	$ 316,050	$ 316,100		4	$ -	$ -	$ -	$ 403,433
ST52	Alpine	Recommended based on CCTV score	118246	Condition		$ 369,000			$ 18,450	$ 387,450	$ 387,500		1	$ -	$ -	$ 471,009	$ -
ST53	Hellinger	Recommended based on CCTV score	111001	Condition		$ 423,000			$ 21,150	$ 444,150	$ 444,200		1	$ -	$ -	$ 539,928	$ -
ST54	Hazel Glen	Recommended based on CCTV score	110159, 110154	Condition		$ 311,000			$ 15,550	$ 326,550	$ 326,600		2	$ -	$ 378,080	$ -	$ -
ST55	Stoke	Recommended based on CCTV score	110577	Condition		$ 444,000			$ 22,200	$ 466,200	$ 466,200		4	$ -	$ -	$ -	$ 595,002
ST56	Driftwood	Recommended based on CCTV score	109900	Condition		$ 442,000			$ 22,100	$ 464,100	$ 464,100		1	$ 537,254	$ -	$ -	$ -
ST57	Fisher Hallman	Recommended based on CCTV score	108906	Condition		$ 544,000			$ 27,200	$ 571,200	$ 571,200		4	$ -	$ -	$ 694,297	$ -
ST58	West Heights	Recommended based on CCTV score	108878	Condition		$ 654,000			$ 32,700	$ 686,700	$ 686,700		4	$ -	$ -	$ 834,688	$ -
ST59	Overlea	Recommended based on CCTV score	108477	Condition		$ 391,000			$ 19,550	$ 410,550	$ 410,600		1	$ 475,321	$ -	$ -	$ -
ST60	Stoneybrook	Recommended based on CCTV score	108198	Condition		$ 441,000			$ 22,050	$ 463,050	$ 463,100		2	$ -	$ 536,096	$ -	$ -
ST61	Berberry	Recommended based on CCTV score	108147	Condition		$ 412,000			$ 20,600	$ 432,600	$ 432,600		4	$ -	$ -	$ -	$ 552,119
ST62	Sandstones	Recommended based on CCTV score	107604, 107656	Condition		$ 503,000			$ 25,150	$ 528,150	$ 528,200		4	$ -	$ -	$ -	$ 674,132
ST63	Cherry Hill	Recommended based on CCTV score	107321	Condition		$ 232,000			$ 11,600	$ 243,600	$ 243,600		1	$ -	$ 296,097	$ -	$ -
ST64	Coach Hill	Recommended based on CCTV score	107218	Condition		$ 607,000			$ 30,350	$ 637,350	$ 637,400		1	$ -	$ -	$ 774,764	$ -
ST65	Coach Hill	Recommended based on CCTV score	107306	Condition		$ 371,000			$ 18,550	$ 389,550	$ 389,600		1	$ -	$ -	$ 473,561	$ -
ST66	Selkirk	Recommended based on CCTV score	107224	Condition		$ 395,000			$ 19,750	$ 414,750	$ 414,800		1	$ 480,183	$ -	$ -	$ -
ST67	Highland	Recommended based on CCTV score	106642	Condition		$ 361,000			$ 18,050	$ 379,050	$ 379,100		1	$ -	$ 438,856	$ -	$ -
ST68	Paulander	Recommended based on CCTV score	106329, 106334	Condition		$ 552,000			$ 27,600	$ 579,600	$ 579,600		2	$ -	$ 704,507	$ -	$ -
ST69	Weichel	Recommended based on CCTV score	106299	Condition		$ 444,000			$ 22,200	$ 466,200	$ 466,200		1	$ -	$ 566,669	$ -	$ -
ST70	Belmont	Recommended based on CCTV score	106093	Condition		$ 458,000			$ 22,900	$ 480,900	$ 480,900		1	$ -	$ 584,537	$ -	$ -
ST71	Union	Recommended based on CCTV score	109083	Condition		$ 319,000			$ 15,950	$ 334,950	$ 335,000		4	$ -	$ -	$ 407,195	$ -
ST72	Union	Recommended based on CCTV score	104911, 106005	Condition		$ 699,000			$ 34,950	$ 733,950	$ 734,000		4	$ -	$ -	$ -	$ 936,791
ST73	Guelph	Recommended based on CCTV score	105106	Condition		$ 409,000			$ 20,450	$ 429,450	$ 429,500		4	$ -	$ -	$ 522,060	$ -
ST74	Wheatfield	Recommended based on CCTV score	103895	Condition		$ 226,000			$ 11,300	$ 237,300	$ 237,300		4	$ -	$ -	$ -	$ 302,862
ST75	Manitou	Recommended based on CCTV score	103436, 100060	Condition		$ 997,000			$ 49,850	$ 1,046,850	$ 1,046,900		1	$ -	$ 1,211,918	$ -	$ -
ST76	Upper Canada	Recommended based on CCTV score	103415	Condition		$ 405,000			$ 20,250	$ 425,250	$ 425,300		1	$ -	$ -	$ 516,955	$ -
ST77	Old Mill	Recommended based on CCTV score	103117	Condition		$ 486,000			$ 24,300	$ 510,300	$ 510,300		1	$ 562,605	$ -	$ -	$ -
ST78	Old Mill	Recommended based on CCTV score	103038	Condition		$ 346,000			$ 17,300	$ 363,300	$ 363,300		4	$ -	$ -	$ -	$ 463,673
ST79	Arrowhead	Recommended based on CCTV score	103052, 103053	Condition		$ 508,000			$ 25,400	$ 533,400	$ 533,400		1	$ -	$ -	$ 648,351	$ -
ST80	Grass Valley	Recommended based on CCTV score	102641	Condition		$ 401,000			$ 20,050	$ 421,050	$ 421,100		1	$ -	$ -	$ 511,850	$ -
ST81	Lower Canada	Recommended based on CCTV score	102928	Condition		$ 180,000			$ 9,000	$ 189,000	$ 189,000		1	$ -	$ 218,791	$ -	$ -
ST82	Dumfries	Recommended based on CCTV score	102325	Condition		$ 479,000			$ 23,950	$ 502,950	$ 503,000		4	$ -	$ -	$ -	$ 641,970
ST83	Heritage	Recommended based on CCTV score	102231	Condition		$ 574,000			$ 28,700	$ 602,700	$ 602,750		4	$ -	$ -	$ -	$ 769,215
ST84	Heritage	Recommended based on CCTV score	102210	Condition		$ 417,000			$ 21,850	$ 438,850	$ 438,900		1	$ 531,234	$ -	$ -	$ -
ST85	Nelson	Recommended based on CCTV score	102207	Condition		$ 576,000			$ 28,800	$ 604,800	$ 604,800		1	$ -	$ -	$ 735,138	$ -
ST86	Burbank	Recommended based on CCTV score	101738	Condition		$ 295,000			$ 14,750	$ 309,750	$ 309,800		4	$ -	$ -	$ -	$ 395,392
ST87	Kine	Recommended based on CCTV score	101278	Condition		$ 527,000			$ 26,350	$ 553,350	$ 553,400		1	$ -	$ 640,630	$ -	$ -
ST88	Wyandotte	Recommended based on CCTV score	100995	Condition		$ 499,000			$ 24,950	$ 523,950	$ 524,000		1	$ -	$ -	$ 636,925	$ -
ST89	Morrison	Recommended based on CCTV score	100891	Condition		$ 204,000			$ 10,200	$ 214,200	$ 214,200		4	$ -	$ -	$ -	$ 273,380
ST90	Morrison	Recommended based on CCTV score	100972, 100973	Condition		$ 699,000			$ 34,950	$ 733,950	$ 734,000		4	$ -	$ -	$ -	$ 936,791
ST91	Burnett	Recommended based on CCTV score	100921	Condition		$ 343,000			$ 17,150	$ 360,150	$ 360,200		1	$ -	$ -	$ 437,825	$ -
ST92	Brookview	Recommended based on CCTV score	100776	Condition		$ 352,000			$ 17,600	$ 369,600	$ 369,600		1	$ -	$ -	$ 427,858	$ -
ST93	Siebert	Recommended based on CCTV score	100628	Condition		$ 283,000			$ 14,150	$ 297,150	$ 297,200		1	$ -	$ -	$ 361,248	$ -
ST94	Greenfield	Recommended based on CCTV score	100602	Condition		$ 451,000			$ 22,550	$ 473,550	$ 473,600		1	$ -	$ 548,251	$ -	$ -
ST95	Broadmoor	Recommended based on CCTV score	100324	Condition		$ 340,000			$ 17,000	$ 357,000	$ 357,000		4	$ -	$ -	$ -	$ 455,633
ST96	Hillmount	Recommended based on CCTV score	100303	Condition		$ 226,000			$ 11,300	$ 237,300	$ 237,300		1	$ -	$ 288,440	$ -	$ -
ST97	Canrai	Recommended based on CCTV score	100146	Condition		$ 304,000			$ 15,200	$ 319,200	$ 319,200		1	$ -	$ 387,990	$ -	$ -
ST98	Trainor	Recommended based on CCTV score	100075	Condition		$ 399,000			$ 19,950	$ 418,950	$ 419,000		1	$ 485,045	$ -	$ -	$ -
Sub-Total Short Term Projects											$ 48,547,200			$ 9,776,146	$ 13,131,983	$ 18,091,475	$ 17,166,541
Medium Term Projects (2028 - 2031)													Priority	2028	2029	2030	2031
MT1	Dalewood	Replacement of 3 lengths of sewer on Dalewood, 2 lengths of sewer on Penrose and one length of sewer through the easement - all pipes upgraded to 300mm dia.	2129581, 2129580, 2129579, 1011151, 101152, 101361	Capacity	409	$ 900,000	$ 270,000	$ 234,000	$ 58,500	$ 1,462,500	$ 1,463,000	This is an existing condition and should be remedied in the short term but project moved to 2028 to allow the City to study further.	1	$ 1,960,560	$ -	$ -	$ -
MT2	Upstream of King St SPS	Replacement of 2 lengths of sewer - upsize from 300 dia. to 375 dia.	100468, 100469	Capacity	140	$ 499,000	$ 149,700	$ 129,740	$ 32,435	$ 810,875	$ 811,000	This is an existing condition and should be remedied in the short term but project moved to 2028 to consolidate with Region roadworks project	1	$ 1,086,818	$ -	$ -	$ -
MT3	New Dundee PS	Increase PS to 75 L/s firm capacity - project involves adding two new pumps		Capacity		$ 477,336	$ 143,201	$ 124,107	$ 31,027	$ 775,671	$ 776,000		2	$ -	$ 1,091,910	$ -	$ -
MT4	Robert Ferrie	Replacement of 1 length of sewer downstream of New Dundee PM discharge to 375mm dia.	2083719	Capacity	52	$ 495,550	$ 148,665	$ 128,843	$ 32,211	$ 805,269	$ 805,000		3	$ -	$ -	$ 1,189,952	$ -
MT5	All Pumping Stations	Recommended from Cond. Assessment Reports		Condition		$ 5,390,522				$ 5,390,522	$ 1,193,000	Budget adjusted from Condition Assessment Reports per City direction		$ 390,522	$ 419,498	$ 440,473	$ 462,497
Sub-Total Medium Term Projects											$ 5,048,000			$ 3,446,899	$ 1,511,408	$ 1,629,825	$ 462,497
Long Term Projects (2032 - 2051)																	
LT1	Manchester	Replacement of 2 lengths of sewer to 825mm diameter downstream of Shirley and Manchester SPS discharge	101713, 101714	Capacity	220	$ 693,015	$ 207,905	$ 180,184	$ 45,046	$ 1,126,149	$ 1,126,149						
LT2	All Pumping Stations	Recommended from Cond. Assessment Reports		Condition		$ -			$ -	$ -	$ 596,259	Budget amount provided by City for 2032-3 only					
Sub-Total Long Term Projects											$ 1,722,408						
Total All Projects											$ 55,317,608						

Data Acquisition & Management Programs

Annual amounts adjusted for inflation

			Total length (m)	Estimated Cost ($/m)	Contingency Allowance (20%)	Engineering Review (15%)	Estimated Total Cost (2022 Base Year)	2024	2025	2026	2027
DA 1	Trunk Sewer Condition Assessment	CCTV for all trunk sewers (>375 mm dia.) for pipes which are greater than 25 yrs age. CCTV cycle is every 10 yrs	66,700	$ 6.00	$ 80,040	$ 60,030	$540,270	$ 148,912	$ 156,358	$ 164,175	$ 172,384
* does not include current budget for hot spot flushing											
DA 2	Forcemain Condition Assessment	Condition assessment for all forcemains which are greater than 25 yrs age completed using Smartball technology. Cycle is every 10 yrs. Cost is generated based on completing 5 forcemains per year with the work being completed on all 5 as one operation.					$776,000	$ 213,885	$ 224,579	$ 235,808	$ 247,599
DA 3	I/I Reduction and Mitigation Program						$3,174,358	$782,771	$944,159	$998,402	$1,055,958
DA 4	Rainfall and Flow Monitoring Program						$1,849,181	$275,625	$615,278	$647,920	$682,347
DA 5	Sanitary Hydraulic Model Updates & Maintenance Program						$804,000	$469,665	$145,861	$153,154	$160,811
DA 6	Hydrogen Sulfide Monitoring Program						$316,000	$207,270	$74,088	$77,792	
Total Data Acquisition and Management Programs							$7,459,810	$2,098,132	$2,160,322	$2,277,252	$2,319,098.42